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Studies on Actinopodous Holothurioidea.*

By

K. Mitsukuri,

Ph. D., Rigakuhakushi,

Late Professor of Zoölogy, Sci. Coll., Tokyo Imp. Univ.

With 8 plates and 55 textfigures.

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* The late Professor Kakichi Mitsukuri was for more than ten years engaged in the study of Japanese Holothurians, with the intention of publishing the results in the form of a monograph. This work was brought to an end by the failure of his health in 1907. In his

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capacity as Dean of the College of Science, and in other official relations, many responsibilities devolved upon Professor MITSUKURI, so that he could devote only a limited portion of his time to his favorite study. To this he often alluded with regret.

After his death, on September 17th. 1909, all the notes, manuscripts, drawings, photographs and preparations left by him relative to the subject, were taken charge of by the undersigned, to whom Professor MITSUKURI had entrusted their publication as far as should be found practicable. In fulfilling this sad duty the editor has been fortunate in securing, as co-editor, Mr. H. OHSHIMA, *Rigakushi*, a student of Professor MITSUKURI's who, at the editor's suggestion, has taken up the Holothurioidea as the subject of his special study.

The two editors found that the notes and manuscripts related chiefly to the actinopodous Holothurioidea and were, for the greater part, nearly or quite ready for publication. In preparing them for the press, a small part, consisting of apparently provisional statements, or referring to doubtful forms, have been omitted. All the notes and figures that remain unpublished will be utilized by Mr. OHSHIMA in his researches, and so far as practicable will be incorporated into his future publication with due acknowledgement of the source.

In bringing this monograph to its present form, credit is due to Mr. OHSHIMA for the laborious work of arranging the manuscript and the plates, and of making for the text careful drawings from the original sketches and photographs.

Had Professor MITSUKURI lived to finish this work himself, it is easy to suppose that it would have assumed a form greatly different from, and incomparably more worthy than, that in which it is now presented.—Prof. I. IJIMA.

Family I. HOLOTHURIIDAE.

Subfamily 1. Synallactinae.

Genus **Pseudostichopus** Théel 1886.

Tentacles 20 (—19). No tentacular ampullae. Stone-canal attached to the body wall. Ambulacral appendages in the form of pedicels, extremely small, difficult to detect and arranged in more or less distinct longitudinal series. Genital tubes in two bundles (one right and the other left). Anus lodged in a vertical furrow, without calcareous teeth. Calcareous deposits in the skin rarely present, and then only sparsely; oftener entirely wanting. The body generally covered with foreign substances like sand grains, sponge spicules, foraminiferan shells etc.

1. *Pseudostichopus trachus* Sluiter.

(Pl. I., figs. 1—5; textfig. 1).

Pseudostichopus trachus Sluiter 1901*a*, p. 15.—Sluiter 1901*b*, p. 52, Taf. V., Fig. 1; Taf. VIII., Fig. 8.—Perrier 1902, p. 337—8.

Specimens examined :—

Sci. Coll., Spec. No.	Number of individuals	Preservation	Size. Length in cm.	Locality	Depth in *hiro**	Collector	Date
1075	Several	Alc.	4.5—5.5	Nishino-Yodomi, Arazaki-line, Nokogiri yama over Mito, Sagami Bay	300	Mitsukuri & Owston	July 30, 1899.
1442	1	„	11	Outside Okinosé, Iwado-line, Sagami Sea	400	Aoki	May 20, 1900.
1443	1	„	12	Off Inatori, Prov. Izu, Sagami S.	—	—	—

* 1 *hiro* = ca. 47 ft.

Sci. Coll., Spec. No.	Number of individuals	Preservation	Size. Length in cm.	Locality	Depth in *hiro*	Collector	Date
1444	1	Alc.	5.2	Outside Okinosé, Iwado-line, Sagami S.	300	Aoki	Nov. 14, 1901.
1466	4	„	Medium size	Nakano-Yodomi, Yahagi-line, Sagami B.	100	„	Aug. 14, 1900.
1473	6	„	Small	Numa, Sagami S.	360	Mitsukuri & Aoki	Aug. 9, 1903.
1474	6	„	Small	Numa, Matsuwa Lighthouse-line, Mera out or not, Sagami S.	330	„	Aug. 23, 1903.
1475	1	„		Urage Channel (north side: Takeyama in line with Amezaki).	230	„	Aug. 27, 1903.
1476	1	„	Small	Mochiyama, Sagami S.	350	„	Aug. 10, 1903.
1482	1	„		Naka-no-Yodomi, Kōzuka-line, Mera not out, Sagami B.	200	„	Aug. 18, 1903.
1884	1	„		Numa. Matsuwa Lighthouse-line, Sagami S.	320	„	Aug. 22, 1903.

Description:—"Das grösste Exemplar 180 mm. lang, 45 mm. breit und 35 mm. hoch. Hinten eine deutliche senkrechte Furche in deren Boden der After liegt. Die Oberfläche mit einer dichten Hülle von Globigerinen Sand. Bauch flach, Rücken hoch gewölbt, scharf gegen einander abgesetzt. Auf dem Seitenrande stehen kleine flache Hautwärzchen, auf welchen die sehr kleinen Füsschen in einer abwechselnden Doppelreihe stehen. Auf dem mittleren ventralen Radius waren die Füsschen sehr klein, fast nur durch die Füsschencanäle zu finden. Auf dem Rücken sind die wenigen kleinen Füsschen unregelmässig verteilt. Mund ventral, die Fühler klein und zurückgezogen. Ich konnte nur 17 zählen, vielleicht kommen aber 20 vor. Kalkkörperchen fehlen in der Haut überall, nur in den Scheiben der Fühler einige wenig zahlreiche Stützstäbe, 0.13 mm. lang, schwach bedornt an den Enden. Längsmuskeln kräftig, als hohe, schmale Ränder in die Körperhöhle hervorragend, mit tiefem Schlitz in der Mitte, ohne aber

ganz gespalten zu sein. Kalkring mit 10 kräftigen, fest verbundenen Stücken, die Radialien mit eigentümlichen Zähnchen an der hinteren Einbuchtung. Eine bis 30 mm. lange Polische Blase. Ein Steincanal, ganz ohne Kalk, aber in die Haut eindringend und neben dem Genitalporus nach aussen mündend. Gonaden als 2 Büschel langer, dünner, nur selten am Ende geteilter Schläuche. Der Geschlechtsgang 60 mm. lang, in der Mittellinie des Rückens 8 mm. hinter dem Peristom ausmündend, ohne Papille. In der Wand der Geschlechtsschläuche keine Kalkkörperchen. Die 2 Kiemenbäume gross, ganz ohne Kalk in der Wand." (Sluiter 1901*a*, pp. 15—16).

Remarks :—The body is in all specimens covered with various foreign substances such as sponge spicules, foraminiferan shells, sand-grains, etc. Sponge spicules and elongate foraminiferan shells are stuck in the skin and look as if they were setae produced by the animals themselves. They make the handling of the animals anything but pleasant, as these needle-like bodies are apt to be left in the fingers. At present, there seems to be some difference in the thickness of this coating in different specimens and in different parts of one and the same specimen, but this is probably due to the fact that the coating has been more or less rubbed off since capture. The mouth is entirely ventral, and although the tentacles are generally drawn in, they are sometimes left extended. At the posterior end, where the coating of foreign substances is especially thick, there is a median vertical furrow, at the ventral end of which is the cloacal opening. This is made plainer when the coating is cleared off.

Tentacles 20 ; but sometimes only 17, 18, or 19 of them can be counted, probably due in part to the difficulty of counting

tentacles in their contracted state, and in part to actual individual variation.

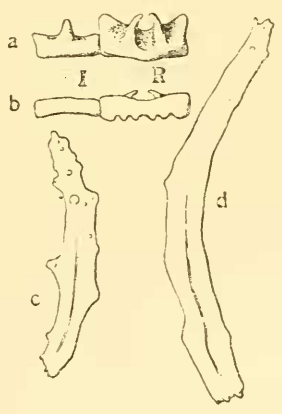
Ambulacral appendages minute, without end-plates, but their shape is more like that of a bluntly ending pedicel than of a conical papilla. The smaller ones among them are no larger than 0.16 mm,, while the larger ones are as much as 1.5—2.0 mm. in length. They can, especially in the larger specimens, be recognized only by the openings or canals seen to enter them from inside. Ambulacral appendages are most numerous on each side of the two lateral ambulacra, which run along the somewhat thickened edge between the dorsum and the ventrum. They are especially numerous in the posterior parts or in those parts which project on each side of the vertical pygal furrow, where, when foreign particles have been cleared off, they project, giving a villous appearance. The largest appendages are along these two ambulacra. On the two dorsal and the median ventral ambulacra, small appendages are found along the two sides of each ambulacrum. These are minute, sparse, and can be seen only when the skin has been mounted as a whole and examined under the microscope.

Calcareous deposits, ordinarily none in the perisome. But in one specimen that I subjected to a thorough examination, there were two calcareous bodies, one on each side of the cloacal opening. On the one side, the body is of a somewhat peculiar shape: it is cup-shaped, the open part consisting of an open latticework, while the basal part (turned toward the posterior end) is of a closer latticework. The body on the other side is somewhat broken, but when complete, it must have been of the same shape. Also in a second specimen, which I subjected to a thorough search, there was on each side of the cloacal opening a calcareous body.

This on one side is a plate of close-meshed latticework. On the other side, it is more like the body in the first specimen, consisting of the open lattice part and the closer lattice part; and the latter looks so much like the piece of the other side, that it is highly probable that it is only a fragment. All things considered, I think it is safe to conclude that there normally exists a calcareous body on each side of the cloacal opening.

In the branches of the tentacles there exist numerous calcareous supporting rods (textfig. 1 *c*, *d*). They are mostly of a bent spindle shape with a few teeth. There is no calcareous body in the genital organs, nor any in the cloacal wall or in the respiratory trees. Also none in the pedicels.

No tentacular ampullae. Two genital bundles; each genital tube simple and short; if branching, so only at the end. In one small specimen, I thought I made out a genital papilla. In others examined, this was not distinct. Stone-canals unfortunately not distinctly made out. In one specimen a canal seemed to accompany the genital duct, but its end could not be ascertained. Polian vesicle single, long. In a specimen 12 cm. long, there was a Polian vesicle 17 mm. long. In this specimen, quite near the base of the vesicle, there were two small appendages with end-knobs which looked very much like the free stone-canals of some holothurians. Longitudinal muscles stand out distinctly in the body-cavity. A groove along the middle of each



Textfig. 1.

Pseudostichopus trachus: *a*—Side view of calcareous ring; *b*—Posterior view of the same; *c*, *d*—Supporting rods of tentacle. ×160.

I—Interradialia; R—Radialia.

band. Along the dorsal median line of the posterior parts of the first and second limbs of the digestive tube, there is a distinct development of the *rete mirabile*. The respiratory tree is also well developed, but neither of the branches in any way comes in contact with the blood vessels.

Calcareous ring as in the figure (textfig. 1 *a*, *b*) ; radialia four-pointed, 7 mm. wide. It is comparatively thick, its cross-section being almost square. When it is looked at from behind, the posterior edge has two (or more ?) teeth on each side of the median incision. Interradialia 5 mm. long, single-pointed.

Hitherto 7 species of *Pseudostichopus* have been described. I am of the opinion that all these are of a very doubtful validity. A thorough re-examination will, I believe, reduce the number. The specimens above described do not agree exactly with any of the species. Nevertheless, I believe they agree sufficiently closely with *Pseudostichopus trachus* Sluiter to admit of their identification with it. The chief point of difference is that there are calcareous anal pieces in my specimens, while there are none such described for *P. trachus*. But it would be very easy to overlook them, especially in large specimens, and Sluiter had only two specimens, which were rather large, being respectively 18 and 15.5 cm. For the rest, the calcareous ring agrees well. Again, there are no calcareous bodies in the ovarian tubes, although this perhaps is not a very important characteristic. Moreover, the localities given by Sluiter are in seas nearer Japan than those of any other species. On the whole, therefore, I prefer to put my specimens in *P. trachus* Sluiter. At the same time, I am prepared to learn at any time that some other species of the genus are synonymous with that species.

Locality:—"Siboga" Stat. 161, near Kofiau I. in the Moluccas, and "Siboga" Stat. 286, near the eastern end of Timor (Sluiter : 01); Sagami Sea.

Genus **Paelopatides** Théel 1886.

2. *Paelopatides appendiculata* Théel.

Paelopatides appendiculata Théel 1886*a*, p. 158.
? *Paelopatides purpureo-punctatus* Sluiter 1901*b*, p. 43.

Specimens examined:—5 individuals from Suruga Bay, 700 *hiro*. Collector Aoki. June 3, 1905. (Sci. Coll., Spec. Nos. 1579—1581).

This is a very striking species. I saw many specimens brought up in the dredge on the "Albatross," when I had the privilege of being on board her, during her expedition in the Sagami and Suruga Seas. It is very large, later measurements showing it to be about 25 cm. long and 12 cm. broad, and about as much in height. While it was one of the commonest among the spoils of the "Albatross," I had never seen one, or a piece of one, brought up by the long line, on which we depended mostly for deep-sea forms. It was only by his diligence and resourcefulness that Kuma Aoki succeeded at last, in June 1905, in bringing up some specimens of this species with a dredge at the same place in which he obtained *Enypniastes eximia* Théel.

While it is such a striking form, it is one of the hardest forms to identify, owing to two circumstances: (1) the total absence of any calcareous spicules and of the calcareous ring, and (2) the difficulty of preserving the specimens in anything like the original shape. The skin comes off almost entirely in

shreds, exposing the white connective tissue and leaving the purple epidermis only as spots here and there on the surface. These purple points on the white surface form the striking feature of the specimens preserved in alcohol.

It is therefore with a great deal of hesitation that I identify these specimens with *Paelopatides appendiculata* of THÉEL. It is more by the absence than by the presence of positive characters that I place these specimens in this species; but there is one fact which has great weight in my own mind. The "Challenger" specimens were obtained at a spot very near Suruga Bay, where all my specimens were obtained. It would not have been at all strange if the same species as that which abounds in that bay had been caught by the "Challenger."

The specimens, when fresh, are stated by AOKI to have been about 25×12 cm. At present they are 12×3.5 cm.; 9.5×3.7 cm.; 9×4 cm. The two extremities are rounded. The mouth is ventral and the anus dorsal. I have not been able to count the tentacles exactly, but there are probably 20 of them.

On the ventral median ambulacrum, there are pairs of large pedicels. These are present throughout nearly the entire length. There are about 17 pairs, but they are absent on the anterior one-sixth of the length. On the outside of the median row and about midway between it and the lateral edge, there is on each side a row of large pedicels which extends over the posterior half of the body, but is lacking on the anterior half. Outside of this row and on the lateral body edge, a single row of large papillae goes entirely around the body; at the anterior end, the row goes across to the other side dorsally to the mouth (19—20 papillae in this part), and at the posterior end, ventrally to the anus. This is all that

may be compared to the brim. On the dorsal surface, there are much more slender papillae scattered apparently without any regularity but with a tendency, it seems to me, to be arranged over the two ambulacra. There are two Polian vesicles. No calcareous spicules can be discovered in the skin. Neither can the calcareous ring be discovered.

It is with very great hesitation that I connect the name of *Paelopatides purpureo-punctatus* of SLUITER with this species, but after repeated and careful perusals I can not help having a suspicion that it belongs there, and I simply record that suspicion. This is very much strengthened by the presence in my specimens of the blind sac mentioned by SLUITER (p. 44) as occurring in the anterior part of the digestive tube. In my specimens, the blind sac should be described as consisting of two parts: one larger dark violet or purple part lobulated and evidently glandular, and a second lighter-colored gland-like part attached to the duct of the first. They seem to open not much behind the circular canal.

The sexual organs are very long, and bundles of smaller bundles in front of well-developed tubes are very distinct. Two respiratory trees are well developed and reach quite to the front.

Locality:—"Challenger" Stat. 235 (THÉEL '86); "Siboga" Stat. 316, 314, 101 (SLUITER: 01); Suruga Bay.

Genus **Synallactes** LUDWIG 1893.

Body cylindrical or subcylindrical. 20 (—18) tentacles. No tentacular ampullae. Stone-canal attatched to the body wall. Ventral surface flattened but without any marginal border. Ventral

pedicels and dorsal papillae in longitudinal series and confined to the ambulacra. On the ventral face, three zones, simple or otherwise, of pedicels. Genital tubes in two bundles (a right and a left). Anus not lodged in a vertical furrow and without any calcareous teeth. Calcareous bodies present in the perisome, of the ground form of a table. The disk consists of three- or four-armed figures, the distal ends of which have a larger or smaller number of perforations, and often laterally send out processes which may unite with similar processes of other arms and produce open circular lattice-work. The spire consists of a single pillar* which may be divided or perforated, or both, at the upper end. There are supporting rods in the ambulacral appendages.

3. *Synallactes triradiata*, sp. n.

(Textfig. 2).

Specimens examined :—

Sci. Coll., Spec. No.	Number of individuals	Preservation.	Size. Length in cm.	Locality	Depth in *hiro*	Collector	Date
1066	6	Alc.	9—11	Maye-no-Yodomi. Ike-line, Sagami Bay.	600	Aoki	Jan. 17, 1896
1445	1	„	10	Merasé, Sagami Sea.	400	„	Jan. 9, 1899
1446	2	„	10.6—11	Okinosé outer edge, Iwado-line, Sagami Sea.	400	„	„
1447	4	„	7.5—11	Okinosé and Yodomi, Sagami Sea.	400	„	April, 1897
1448	1	„	11	Sagami Bay.	400	„	Spring of 1896

* *S. reticulatus* Sluiter is said to possess four pillars or knobs, which fact makes it seem doubtful to me whether the species belongs to this genus.

Sci. Coll., Spec. No.	Number of individuals	Preservation	Size. Length in cm.	Locality	Depth in *hiro*	Collector	Date
1449	2	Alc.	9—9.7	Okinosé outer edge, Iwado-line, Yawata Hills and Sunosaki in line. Sagami Sea.	400	Aoki	Jan. 9, 1897
1451	1	„	4.5	Sengenzuka-line, Sagami Sea.	400	„ (?)	Feb. 26, 1897
1452	2	Formalin		Okinosé, Sagami Sea.	400	„	March, 1901

All the specimens are more or less contracted.

Description :—Tentacles 20, may be reduced to 19 or to 16. Color in alcohol, lighter or darker shades of brown. Some with decided purple tinge, others appear bleached and white. Young specimen translucent without color. Tentacles light yellow, in young specimen of a decided orange color.

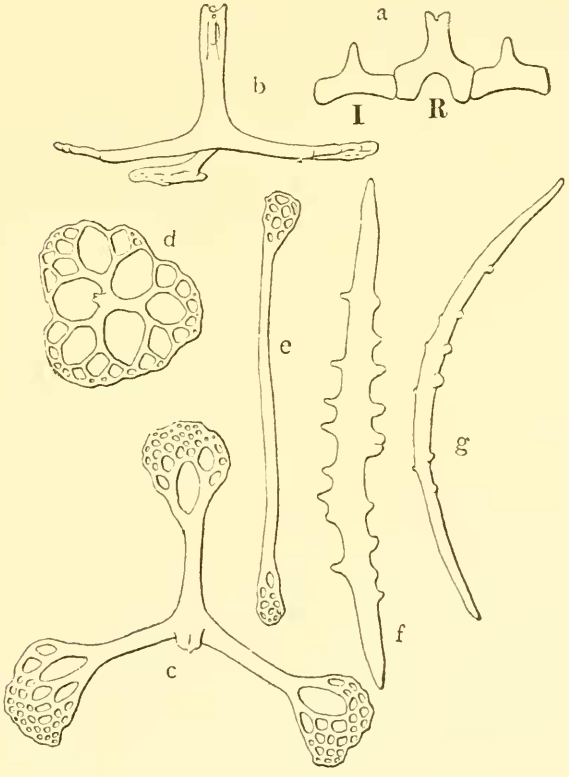
Body cylindrical or subcylindrical, without any marginal border between the ventrum and the dorsum. Tapers much more toward the posterior end than toward the anterior. Mouth ventral, anus terminal.

In the specimens which show the arrangement of the ambulacral appendages best, dorsal papillae are in six longitudinal rows : one on each side at the boundary between the dorsum and the ventrum and belonging to each lateral ambulacrum, and two belonging to each of the two dorsal ambulacra. Each papilla has a large wart-like conical base, from the top of which a much more slender papilla arises. In a specimen which shows this best, the whole dorsum appears as if it were covered entirely by these conical warts, although in fresh specimens there must have been some space between and around their bases. The slender terminal papilla-like part is short in the posterior parts but becomes as long as 8 mm. in the anterior region. The papillae on the dorsal side of the mouth have small bases, but are especially

long and overhang the mouth, being 1 cm. or more long. In a specimen 9.7 cm. long, I am able to count about 27 and 31 conical warts respectively in each of the longitudinal series immediately on both sides of the median line. The ventral pedicels are numerous and are arranged in three longitudinal zones, two lateral and one median. In each lateral zone the pedicels stand alternately in two rows. The middle zone has also numerous pedicels. In the middle portion of the body, they seem in all specimens to be in from three to four zigzag rows, which arrangement seems to be kept up in some specimens to both extremities; but in some others, they are gradually reduced to two rows in the anteriormost and posteriormost parts. In most specimens, the pedicels of the two lateral zones are left protruding, while those of the middle zone are strongly contracted. Moreover, the former seem to be slightly greater both in length and diameter, than the latter. This arrangement is more or less obscured in contracted specimens, and even dorsal conical warts become not very apparent. In the young specimen 4.5 cm. long, the arrangement of ambulacral appendages is very clearly brought out, as there is a great deal of space between their bases. The dorsal papillae are in six distinct rows, although the basal conical warts present are not prominent. In the ventrum, the median zone of pedicels is clearly in two rows, although they show a tendency to be disturbed in this by becoming zigzag, especially in the middle third.

Excepting the supporting rods, the calcareous deposits are of one fundamental type. They nearly all consist of a triradiate basal part, the arms of which stand 120° apart. The distal ends of the arms are more or less enlarged and perforated. The perforation may be single or there may be several. Sometimes

one or more of the arms may be branched, the branching always taking place dichotomously. Only very rarely, and then mostly on ambulacral appendages, there may exist four-armed spicules, the arms being at right angles with one another. From the centre of the triradiate basal disk, there arises a single pillar. The base never shows a trace of four pillars, but the pillar arises as a single monolith. It hardly tapers at all. Sometimes it becomes slightly thicker toward the upper end.



Textfig. 2.

Synallactes triradiata: *a*—Calcareous ring; *b*, *c*—Table-like bodies of dorsal perisome; *d*—Same of ventral perisome; *e*—Supporting rod of dorsal papilla; *f*, *g*—Same of ventral pedicels. (*b*–*g* × 160). I—Interradialia; R—Radialia.

At the upper end, the pillar terminates after first becoming divided into several points; or these points may be united by cross-junctions, leaving perforations between them. These table-like deposits

are of different sizes in different parts of the body. Those in the dorsal perisome (textfig. 2 *b*, *c*) are as a whole larger than those in the ventral perisome ; the largest are found in the basal conical warts of the dorsal papillae (length of the arm measuring from 0.12 to 0.23 mm.). The dorsal surface between the basal conical warts of the papillae is strewn much more sparsely than in the warts with smaller and generally simple triradiate spicules (length of the arm measuring from 0.07 to 0.08 mm.). The calcareous spicules in the ventral perisome (*d*) are on the whole much smaller than those in the dorsal perisome and are also much more sparse (with arms 0.02—0.05 mm. long). Quadriradiate spicules are found in the dorsal papilla above the basal conical warts, but never in any considerable number. In papillae which are drawn out to a fine point there is no terminal disk. In those which are only somewhat contracted at the top, calcareous deposits are crowded and give an appearance as if they formed "a sort of a terminal disc" (Théel) ; but there probably exists no actual disk. In ventral pedicels triradiate spicules are sparse and a terminal disk is distinct. The supporting rods (*f*, *g*) in them have both ends pointed (0.43—0.65 mm. long). In dorsal papillae (*e*) their ends are enlarged and perforated, not pointed (about 0.5 mm. long). Spicules in the tentacles are somewhat like those in the dorsal papillae but smaller (0.11—0.22 mm. long).

Genital tubes in two bundles. Stone-canal single, running directly in front of, and along with, the genital duct attached to the dorsal body-wall. Polian vesicles in one specimen three, of which two are slender and tube-like, and one large and vesicle-like. The large vesicle and one of the slender ones were attached in the left ventral interradius, and the remaining slender one in the

right ventral interradius. A low median genital papilla, 1 cm. behind the base of the tentacles, in a specimen 12 cm. long. Respiratory trees two, their branches not long. The common part rather long, being 2.5 cm. long in a specimen of 12 cm. length. No relation with the circulatory system. Tentacular ampullae represented by slight elevations. Calcareous ring constituted as shown in textfig. 2 *a*. No calcareous deposits in genital organs, respiratory trees or cloacal wall.

Remarks :—The specimens described above agree in many respects with that described by THÉEL under the name of *Stichopus challengeri*. The main points of difference are :

1) Dorsal papillae in THÉEL's specimen are described as scattered over the ambulacra and interambulacra. An arrangement of them in rows is scarcely to be found elsewhere than along the sides of the body, where they evidently belong to the lateral ventral ambulacra ; whereas in my specimens the dorsal papillae are in regular rows as described above. But it must be remembered that THÉEL's specimen was slightly macerated, and those among my specimens which are not well preserved might easily be described in THÉEL's words.

2) The commonest form of the calcareous deposits in THÉEL's specimen is quadriradiate, while in my specimens they are almost without any exception of the triradiate character. There are only a few four-armed exceptions in the walls of papillae and pedicels.

My specimens are also very close to those described by LUDWIG as *Synallactes alexandri*. The only point of difference is that raised as the second point of difference in the above comparison with *Stichopus challengeri*. All other differences are minor.

Now we may regard the specimens of THÉEL and of LUDWIG, as well as my own, as all belonging to one species, in which case my

own specimens may be described as var. *triradiata*. I can detect no difference at all between *St. challengeri* and *Syn. alexandri*, while the points raised by LUDWIG seem to me to be due either to the state of preservation or to the incompleteness of the earlier author's description. If we however put a great deal of weight on the shape of the spicules, the Japanese specimens, which have almost entirely triradiate spicules, might be separated as *Syn. triradiata*. But there are also triradiate spicules in THÉEL's and LUDWIG's specimens, only they are much less numerous than the four-armed ones.

The choice between the two courses is almost entirely a matter of fancy. The safest course perhaps is not to disturb THÉEL's descriptions at all, and to establish my specimens for the present at least as a separate species, leaving the question of identity between the three sets of specimens to be settled by future investigations.

4. *Synallactes discoidalis*, sp. n.

(Textfig. 3).

Specimens examined :—

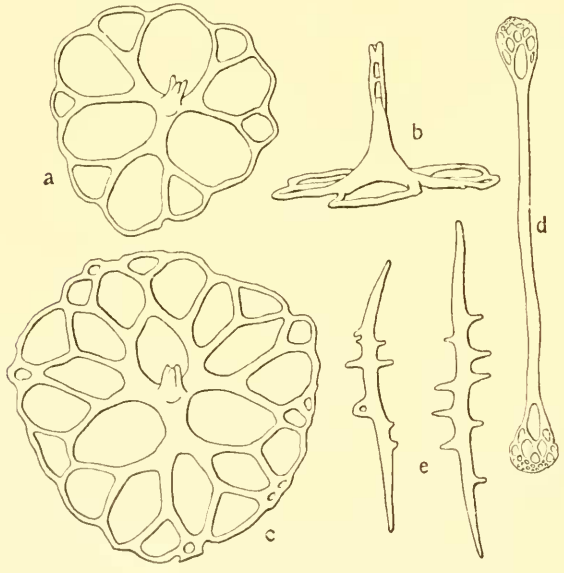
Sci. Coll., Spec. No.	Number of individuals	Preservation	Size in cm.	Locality	Depth in *hiro*	Collector	Date
1067	1	Alc.	6.2 long	Off Odawara, Sagami Bay.	270	Ijima	Aug. 1, 1895
1468	1	„	11 × 1.5 (14 × 2.5 when fresh)	Numa, Sagami Sea.	350	Mitsukuri & Aoki	Aug. 9, 1903
1469	2	„	7 × 1.5	Numa, Sagami Sea.	330	„	Aug. 22, 1903
1518	1	Glyc. mixture		Outside Okinosé, Sagami Sea.	400	Aoki	Apr. 25, 1904

Specimen 1468 was observed in the fresh state.

Description:—Dorsal surface was mottled with irregular, large and small, reddish-brown patches; the largest patch not more than 5 mm. across. But as some of the patches were close together, the whole dorsal surface appeared variegated with reddish-brown areas on lighter ground. The ventral face was uniformly reddish-brown. Prof. Ijima marked specimen No. 1067 at the time of capture "Transparent with crimson markings or patches." His specimen being smaller and therefore younger, the perisome was probably more transparent, and the marking perhaps brighter. These markings entirely disappear in alcohol, and the entire animal becomes translucent and whitish.

Tentacles 20. Dorsal papillae in six rows corresponding to those in *S. triradiata*. Their shape is also the same as that of the papillae in *S. triradiata*, viz., each with a broad wart-like base and a slender distal part. Their length seems to be uniform, i.e., there is no tendency of the slender distal part to grow longer in those papillae placed on the dorsal side of the mouth—a character somewhat marked in *S. triradiata*. In the smallest specimen (No. 1067), dorsal papillae are much shorter than in *S. triradiata*, but are still in six rows. Ventral pedicels in three zones. The two lateral zones with pedicels arranged in two alternate rows; the median zone with same in longitudinal halves, each half with 2—3 alternate rows. The clear space between the zones wider than in *S. triradiata*. Genital tubes in two bundles. Polian vesicle single, about 1.5 cm. long in larger specimen. Stone-canal single, attached to the mesentery, which runs in front of, and parallel with, the genital duct and becomes attached to the body-wall. Anterior processes of the radialia of the calcareous ring usually wide.

The table-like calcareous bodies (textfig. 3*a*—*c*) are built on the same plan in all parts of the body, although there are differences in size and elaboration; 0.09—0.23 mm. in diameter. They are all on the same fundamental plan as those of *S. triradiata*, but the ends of the arms and their branches are united with one another by lateral processes, and a disk-shaped base is thus formed. Triradiate ones very few, except at the base of ventral pedicels. Spire of a single pillar, never in the form of columns. Supporting rods scattered among large basal disks of dorsal papillae (*d*), very long (0.6 mm.); the two ends have many perforations. These rods are irregularly scattered, and even toward the tip of the papilla, although becoming somewhat



Textfig. 3.

Synallactes discoidalis: *a*—*c*—Table-like bodies; *d*—Supporting rod of dorsal papilla; *e*—Same of pedicel.

(*a*—*c*, ×210. *d*, *e*, ×80).

shorter, they do not become as numerous or simple or twisted as in *S. nozawai* or *S. triradiata*. Supporting rods in pedicels (*e*) are like

ordinary supporting rods in the pedicels of *S. triradiata*, and are arranged parallel to the end-plate.

Remarks :—The arrangement and size of ambulacral appendages are different from those of *S. triradiata*. Probably the markings too are different. But above all, the spicules of this species are so strikingly different from those of the other known species of *Synallactes* that I think it must be treated as a new species. The specific name is in reference to the discoidal shape of the base of the tables.

5. ***Synallactes ishikawai***, sp. n.

(Textfig. 4).

Specimens examined :—

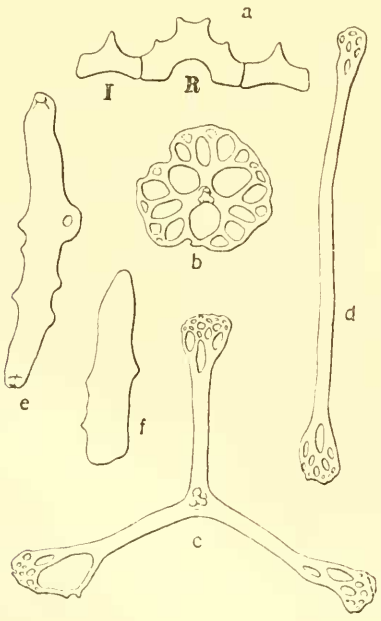
Sci. Coll., Spec. No.	Number of individuals	Preservation	Size in cm.	Locality	Depth in *hiro*	Collector	Date
1453	1	Alc.	11.3×3	Nishi no-Yodomi, Sagami Bay.	130	Owston	Jul. 30, 1899
1154	1	Alc. (probably once in formal.)	14×3	„	300	Aoki	Jun. 16, 1901

Description :—Body subcylindrical; dorsal and ventral surfaces distinct, the ventral somewhat flat. When fresh, of a distinct brown tint. On specially contracted parts, wherever there was a mass produced by contraction, that part had a deep brown color. At present, the color is gone, except from the tips of papillae which remain brown, and the whole body has a dirty white color and a cartilage-like aspect.

Dorsal papillae in six rows, there being two rows on each of the two dorsal ambulacra. The papillae in these two rows stand generally opposite one another at nearly equal distances, so that they form very regular series or lines of papillae from the front backward. There are about 28—40 papillae in each row.

The two remaining rows are each on the edge of the border between the dorsum and the ventrum; each runs in a somewhat zigzag way and consists of about 26—30 papillæ. Ventral pedicels in three zones; each of the two lateral zones with pedicels in two rows and placed nearly alternately near the edge of the ventral surface. The median zone in the middle part consists of 3—4 rows of alternately placed pedicels; anteriorly and posteriorly, the rows are reduced somewhat in number. Both papilla and pedicel seem to have a somewhat enlarged base, but this does not seem to be so large or prominently conical in shape as in *Synallactes triradiata*.

Tentacles 20. Genital bundles two, one right and one left. Polian vesicles two, both long and large, about 2 cm. long. Calcareous ring as shown in textfig. 4 *a*. Tentacular ampullae as in other synallactids, in the form of short out-bulgings. Respiratory trees present. Owing to defective preservation, it is difficult to



Textfig. 4.

Synallactes ishikawai: *a*—Calcareous ring; *b*—Table-like body of ventral perisome; *c*—Same of dorsal perisome; *d*—Supporting rod of dorsal papilla; *e*, *f*—rods of ventrum. (*b*—*f* ×160). I—Interradialia; R—Radialia.

make out details, but they probably present nothing exceptional.

Calcareous deposits in the dorsal perisome (textfig. 4 *c*) very much like those of the other species of *Synallactes*. At the base of dorsal papillae they are especially large. In the basal part there also exist curved supporting rods with both ends perforated (*d*). There are some very weakly developed terminal plates. The ventral perisome has very characteristic calcareous deposits. There is a lower, very thickly crowded layer of rods (*e*, *f*), and scattered over these are discoidal triradiate tables (*b*). In the ventral pedicels the rods and tables are of the same general character as those of the ventral perisome. At the base there are no specially large tables. There is numerically a somewhat larger proportion of the triradiate type in comparison with the circular ones. End-plates well developed.

Remarks :—The species is named for my friend Dr. Ishikawa, Professor of Zoology in the College of Agriculture, Tokyo Imperial University.

6. *Synallactes nozawai*, sp. n.

(Textfig. 5).

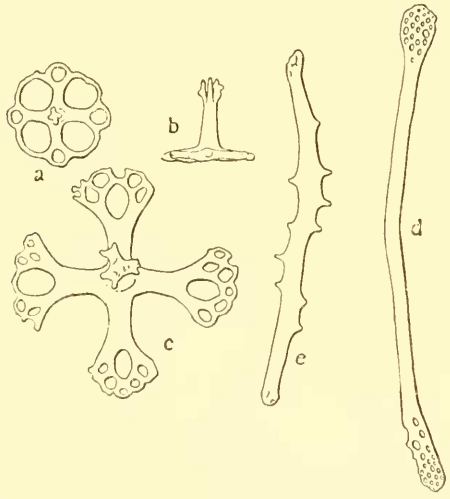
Specimen examined :— One alcoholic specimen from Hokkaidō. Nozawa don. et coll. (Sci. Coll. Spec. No. 1450).

Description :—The single specimen at my disposal differs in several respects from *S. triradiata*, and at the same time does not agree with any known species, so that I have little hesitation in making it a new species.

At present it is contracted, measuring 9 cm. in length. The color is pale with a violet tinge. In fresh state probably much more violet.

I can count 18 tentacles in the specimen. Ambulacral ap-

pendages somewhat contracted, but it can be made out that the dorsal papillae are in six rows, as described for *S. triradiata*. Each dorsal papilla has also a large conical mamma-like base as in that species. Ventral pedicels in three zones; the two lateral zones belong to the lateral ambulacra, each showing a double alternate row of pedicels. The middle zone has much fewer pedicels than in *S. triradiata*, but not so few as in *S. crucifera*. On the whole, the lateral pedicels seem to be larger and more prominent than the midventral pedicels.



Textfig. 5.

Synallactes nozawai: *a*, *b*—Cruciform bodies of ventrum; *c*—Same of dorsal papilla; *d*, *e*—Supporting rods of dorsal papilla. (*a*—*c* ×160; *d*, *e* ×80).

Genital bundles two. Stone-canal one, attached to the dorsal mesentery; it runs in front of, and parallel with, the genital duct, and is finally lost in the skin. Polian vesicle one, long and slender, 21 mm. long. Posterior notch of the radial pieces in the calcareous ring very deep. Other parts eviscerated.

Cruciform calcareous bodies or table-like bodies are largest in the basal conical part of dorsal papillae (textfig. 5 *c*). They are of about the same size in the remaining parts of the dorsal perisome and in the ventral perisome. Many are united

into circular disks by the union of the growths from the distal ends of the cross-arms (*a*, *b*). Pillar single. There is a marked peculiarity in the supporting rods of the dorsal papillae. In their conical or mammae-like basal part, there are, mixed with large cruciform bodies, very long bent rods, the two ends of which are enlarged and perforated like lattice-work (*d*). These rods form a very prominent feature. They pass gradually into thorny, bent supporting rods exactly like those described in the papillae of *S. triradiata*, underlying the layer of quadriradiate spicules (*e*). Spicules are very much crowded at the tip of papillae, and I can not detect any distinct end-plate. Pedicels have similar cruciform bodies and supporting rods. They have a well developed end-plate.

Remarks :—The principal points which distinguish this species from *S. triradiata* are : 1) the ventral median zone has fewer pedicels ; 2) spicules are nearly all quadriradiate, and very rarely triradiate ; 3) large and peculiar supporting rods, present in the wart-like conical basal parts of dorsal papillae together with the cruciform bodies, form a very prominent feature. This also distinguishes it from *S. challengeri* or *S. alexandri*.

I take pleasure in naming this for my friend and former pupil, Mr. S. Nozawa, zoologist to the Fisheries Department of the Hokkaido.

Genus **Bathyplotes** Östergren 1896.

7. *Bathyplotes golden-hindi*, sp. n.

(Pl. II., figs. 16—17; textfig. 6).

Specimens examined :—

Sci. Coll., Spec. No.	Number of individuals	Preservation	Locality	Depth in *hiro*	Collector	Date
1479	1	Alc. Glyc.	Uraga Channel, north side, Takeyama in line with Amezaki.	330	Mitsukuri & Aoki	Aug. 27, 1903.
1480	1	„	„	330	„	Aug. 28, 1903.
1481	1	Alc.	„	330	„	„

Description :—This beautiful and striking holothurian is given in natural color and size in Pl. II., figs. 16—17. The body is subcylindrical; dorsum convex and ventrum flat. In active life there is probably some slight marginal border; when the sketch was made this was no longer well-marked except at the anterior and posterior ends, but its place was marked by a single series of large transparent papillae which went around the whole body. These papillae were of about the size given in the figures, the largest being about 6 mm. in height. At the time of capture, all were larger and are said to have made a beautiful row. The series went anteriorly dorsal to the mouth and posteriorly ventral to the anus. At a little over one-fifth of the entire body length from the anterior end, the body was on the sides slightly constricted as in a neck, separating the anterior head-like portion from the rest of the body. This did not seem like a temporary constriction produced by contraction of the circular muscles, but to

be a permanent feature of the body configuration. However, it is lost in the preserved specimens. Ventrally, the median ambulacrum is entirely naked. It was already marked, when the sketch was made, by a deep groove as in the figures. A zone of light yellow pedicels, forming two irregular rows, was found on each side inside the series of marginal papillae. The pedicels were ascertained by means of sections to belong to lateral ambulacra. Anteriorly, they stopped at the neck-like constriction, and did not extend into the head-like portion.

Dorsally the papillae, which were all of a fairly uniform size smaller than the marginal papillae, appeared to be irregularly distributed in two longitudinal zones, each corresponding to one of the dorsal ambulacral fields. In each zone, the papillae were in three rows, standing more or less regularly alternate in their positions.

The mouth was distinctly ventral. In it 20 tentacles, each with transparent stem and brown crown, were found. They seemed all uniform in size, i.e., there were none marked as ventral by their small size. The anus was distinctly dorsal in position and circular in shape, with somewhat raised rim.

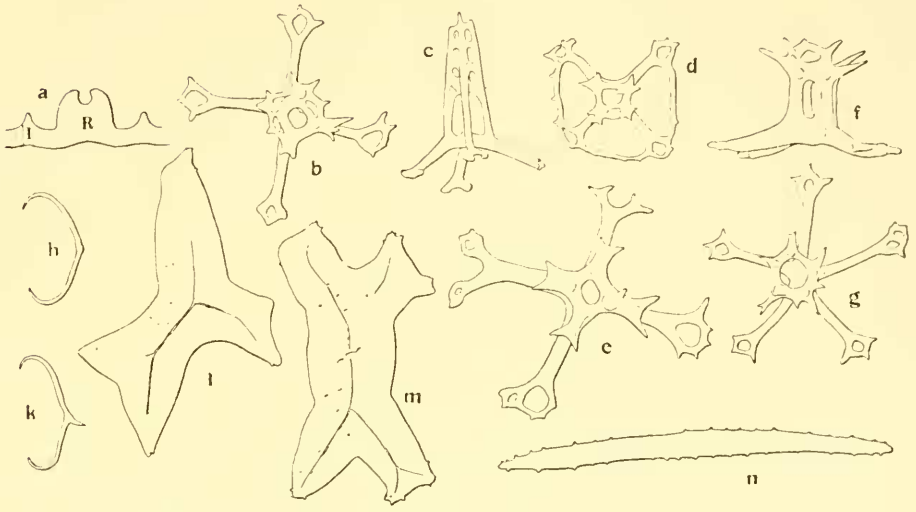
The color of the animal was of a carmine red, deepest in the median dorsal area. It is possible that the whole body was of this deep shade when alive.

Genital bundles two, red-colored and branched. Calcareous ring in one specimen not distinct: in its place there seemed to be some calcareous deposits, but no well formed pieces. In another specimen the ring was imperfect and weakly developed, but the pieces could be made out as shown in textfig. 6 *a*. Polian vesicle one, long, cylindrical, 4 cm. long. Its tip not specially colored. No tentacular ampullae. Respiratory trees tolerably well developed,

both opening separately but close together into the cloaca and extending to about the middle of the body. Their stem large, branches short.

Calcareous deposits consist, speaking in general terms, of C-shaped bodies (textfig. 6 *h*, *k*) and cross-shaped tables (*b*—*f*). Of these there are various modifications in different parts (*g*, *l*, *m*). In one specimen, the C-shaped bodies are very numerous (0.05—0.09 mm. in long diam.). They lie at about the same level as the cross-shaped bodies. In a second specimen, the C-shaped bodies are scarce in the anterior parts, both ventral and dorsal, so that their presence there was ascertained only after careful searching. They are however rather numerous among the large X-shaped bodies in the posteriormost parts of the ventral surface. In a third specimen, C-shaped deposits are again very scarce, and were found only after a most careful search. Even in this specimen, they are tolerably common among the large and thick X-shaped spicules in the posteriormost ventral parts. There are a few C-shaped bodies in the cloacal wall.—Cross-shaped tables (*b*—*g*) are somewhat scantily scattered in the perisome. They seem most sensitive to the action of acid reagents. Both ventrally and posteriorly they are of about the same size and shape. The disk of the table consists of four arms, frequently of five (*g*). The ends of two or more arms may be united. On the disk is built a rather badly developed spire, with four pillars and one or two cross-beams. Crown very irregular, with several teeth, spreading out laterally. Both the disk and the spire and crown present various degrees of imperfection. On the whole, the anterior body parts, both ventral and dorsal, possess tables smaller than those in the posterior parts. In the former they are 0.05—0.084 mm. large, while in the latter the larger

ones may exceed 0.1 mm., reaching up to 0.12 mm. in size. In the dorsal papillae, there are found tables with cross beams



Textfig. 6.

Bathyplotes golden-hindi: *a*—Calcareous ring; *b*—*g*-Tables (*c*—of dorsal papilla; *g*—modified to 5-radiate); *h*, *k*—C-shaped bodies: *l*, *m*—Irregular X-shaped bodies; *n*—Supporting rod. (*b*—*k* and *n* ×ca. 270; *l*, *m* ×200). I—Interradialia; R—Radialia.

up to four or five in number (*c*). In the very posteriormost part on both ventral and dorsal surfaces, the calcareous bodies present striking features. Here among tables of the ordinary sort are found very robust ones as large as 0.2 mm., when measured from one end of a cross-arm to that of the opposite arm. Together with these huge four-armed tables there are, in a layer below them, large irregular calcareous bodies which are fundamentally X-shaped and present all sorts of irregularities (*l*, *m*). They are over 0.2 mm. in their longest

diameter. They occur in the posteriormost parts which extend on the dorsal surface about half a centimetre and on the ventral surface about 2 cm., in front of the posterior marginal border. So far as I can ascertain, they are not found in the lateral margins of the body, nor in the marginal border in front of the head. Supporting rods (*n*) are found in the pedicels and papillae. They are large in the ventral pedicels, the smallest measuring 0.38 mm. They are roughened at the ends. In the dorsal papillae the rods are shorter and more slender, being only 0.17 mm. long. Well developed end-plates are found in the ventral pedicels. They are imperfect in the dorsal papillae. I can find none in the marginal papillae.

Remarks :—This species is very close to *Bathyplotes rubicundus* Sluiter, but there are some differences :—

(1) The most important difference lies in the presence of the large irregular calcareous bodies in the posteriormost parts of the body in the present species. Sluiter makes no mention of such bodies in *B. rubicundus*. I think it barely possible that Sluiter overlooked these bodies.

(2) In the new species there are 20 tentacles, all alike in size, while for *B. rubicundus* it is distinctly stated by Sluiter that there are only 12 short tentacles, of which the two ventral ones are much smaller than the others.

(3) The color of body in my species is carmine red, while *B. rubicundus*, to judge from the sketch given by Sluiter, is brick red.

(4) The longitudinal muscle is distinctly divided into two in my species, while it is said to be undivided in *B. rubicundus*.

(5) Marginal papillae are much larger than dorsal papillae

in my species, while the contrary is stated to be true in *B. rubicundus*. This may possibly be due to the state of preservation in SLUITER's specimens.

On the whole, I think, there is no way but to make this a new species. I name it for the yacht "Golden Hind," owned by Mr. A. OWSTON of Yokohama, which was wrecked during a storm in 1903, and whose honorable record in the exploration of the Sagami Sea deserves to be kept in memory by zoological science in Japan.

8. *Bathyplotes moseleyi* (THÉEL).

(Textfig. 7).

Stichopus moseleyi THÉEL 1886*a*, pp. 165—7, Pl. X., figs. 19, 20.—LUDWIG 1889—92, p. 331.

Bathyplotes moseleyi ÖSTERGEN 1896, p. 355.—LUDWIG 1898*a*, p. 8.

Synallactes (?) [*Stichopus*] *moseleyi* PERRIER 1902, pp. 339, 349.

Specimens examined :—

Sci. Coll., Spec. No.	Number of individuals	Preservation	Size in cm.	Locality	Depth in *hiro*	Collector	Date
1063	2	Alc.	6	Okinosé Bank, Mera hills all out, Sagami S.	300	Aoki	Apr. 15, 1894.
1453	1	„		Okinosé Bank, inner edge, Ina-line, Sagami S.	350	„	Dec. 15, 1894.
1457	1	„		Okinosé Bank, Sagami S.	350	„	Dec. 18, 1900.
1458	1	„	2.8	Okinosé Bank, outer edge, Iwado-line, Sagami S.	350	„	Feb. 14, 1897.
1459	1	„	3	„	400	„	Mar. 14, 1896.
1460	1	„	3	„	400	„	Jan. 20, 1897.

Sci. Coll., Spec. No.	Number of individuals	Preservation	Size in cm.	Locality	Depth in *hiro*	Collector	Date
1461	3	Formal.		Nishi-no-Yodomi, Sagami B.	300	Aoki	June 16, 1901.
1069	1	Alc.		Nishi-no-Yodomi, Arazaki-line, Nokogiriyama over Mito, Sagami B.	300	Owston	July 30, 1899.
1463	1	„		Sagami S. (Sengenzuka-line)	400	Aoki	Feb. 26, 1897.
1464	1	Formal.		Matsuwa-Lighthouse-line, Nago Hil 2 out, Tokyo B.	400—450	Mitsukuri & Aoki	
1465	1	Alc.	1.4	Numa, Matsuwa-Lighthouse-line, Sagami S.	400	Aoki	Feb. 10, 1897.
1470	1	„	7.5 × 2.5	Uraga Channel, near Ukishima.	350	Mitsukuri & Aoki	Aug. 11, 1903.
1471	3	„		„	350	„	„
1472	1	Formal.	4.5 × 1.5	„	350	„	„
1477	1	Alc.		Numa, Sagami S.	350	„	Aug. 9, 1903.

Description :—" Body elongated, almost cylindrical, probably slightly flattened on the ventral surface. Mouth bent toward the ventral surface; anus almost terminal. Ventral surface with three series of pedicels, the middle one forming a thin double row, the two lateral a simple zigzag row. Each of the two dorsal ambulacra with a narrow double row of small conical papillae. The two dorsal interambulacra carry a number of low whitish warts; the ventral surface also contains such warts though more sparingly. A crown of small papillae surrounds the mouth. Tentacles about seventeen (?). Body-wall thin and pliable, supported by tables of a characteristic form; the disks are cross- or star-like, with from four to eight arms radiating from a common centre, and with the ends of the arms enlarged, flattened, and pierced with holes; sometimes the enlarged ends of some or all

of the arms are connected with one another, thus constituting a perforated plate; the spire is composed of four rods, and one, seldom two, transverse beams; the spire is often devoid of transverse beams. The top of the spire is irregularly spinous, often with four larger teeth. Colour in alcohol, whitish, inclining to violet or rose. Length of the largest specimen, 140 to 150 mm." (THÉEL).

Remarks :—It is somewhat remarkable that this species, which has not been found since the "Challenger" dredged it along the Chilian coast, should be caught in the Sagami Sea, and that in large numbers. A careful study has failed to reveal points which might serve to separate the Sagami Sea specimens from those of the Chilian coast, at least so far as one can obtain an idea of the latter from the descriptions and figures.*

All my specimens are much smaller than the "Challenger" specimens. Tentacles 20, often only about 17 can be counted. Body in some almost cylindrical, in others more or less flattened; distinctly divided into the ventrum and the dorsum, especially so in young specimens (Spec. No. 1463, etc.). In the fresh state, the body is distinctly flattened. Mouth subventral, anus subdorsal. Mouth surrounded by a circle of papillae.

In the ventrum the median ambulacrum with pedicels; these in the older specimens arranged alternately in a double row or more crowdedly in the large part of the middle region of the body. The pedicels often become concealed in a longitudinal groove which

* The following is an additional note made by the author in pencil, dated Oct. 10, 1903 :— The presence of numerous pedicels on the odd ventral ambulacrum makes it not desirable to put this species in *Bathyplotes*, while its flattened shape and calcareous spicules (4-pillared tables) do not stand in favor of referring it to *Synallactes*. Neither can it be a *Paelopatides* as the middle odd ambulacrum has more than two rows of pedicels. The characters indicated,, together with the presence of peculiar lateral warts, seem to justify the erection of the species under treatment into a new genus which might be called *Östergrenia*.

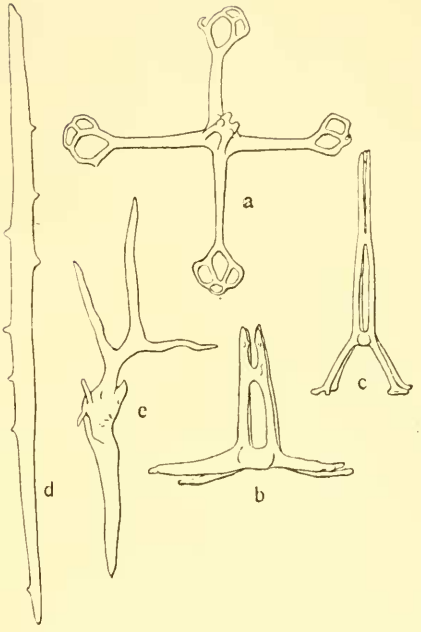
is produced in contracted specimens. In young specimens the number of pedicels in this ambulacrum is rather small. Lateral ventral ambulacra with pedicels in double alternate row, but more crowded in the middle parts. On the dorsum, rather large conical papillae on each of the two dorsal ambulacra. They appear to form a double or a zigzag row in large specimens, but are in a single row in small specimens.

The peculiar structure of this species consists in the low warts referred to by THÉEL. On the two lateral dorsal interambulacra and on the ventral surface, outside the lateral rows of pedicels, there are seen a number of white spots, especially numerous in the middle parts of the body. THÉEL has remarked that these look like contracted pedicels, but are different from them in that they are utterly devoid of any calcareous deposits, end-plates, or other calcareous bodies. These statements I am able to corroborate. The spots or bodies in question are simple fungiform papillae, most of which possess each a single small spicule in the centre, probably representing a rudimentary end-plate (textfig. 7 *c*). It seems to me that the papillæ are a peculiar modification of ambulacral appendages.

Polian vesicle one, large. Genital bundles two. Respiratory trees in two branches, no *rete mirabile*.

Calcareous deposits are remarkably uniform. There seems to be no difference between those of the dorsal and ventral surfaces, nor between those of the anterior and posterior parts of the body. They consist almost entirely of four-armed tables 0.12 mm. in diam. (*a*—*c*). The spire consists of four columns which are united some distance below the tip (*b*). The tips end in four free teeth. Near the top of dorsal papillae, the spire is more slender, and higher (0.076 mm.), and the basal part more vaulted (*c*). Supporting

rods (*d*) are very scarce. In the pedicels, they are found in a small number around and near the end-plate which is well developed. Some dorsal papillae seem to have small end-plates with few holes. There seem to exist a very few supporting rods.



Textfig. 7.

Bathyplotes moseleyi: *a*—*c*-Tables; *d*-Supporting rod; *e*-Spicule at the end of the rudimentary papilla. (× 300).

Locality:—"Challenger" Stat. 306A, 308, 311, The Pacific near the southern extremity of South America (THÉEL '86); Sagami Sea; Tokyo Bay.

9. *Bathyplotes tizardi* (THÉEL).

(Textfig. 8).

Stichopus (?) tizardi THÉEL 1882*a*, p. 696.

Stichopus tizardi THÉEL 1886*a*, p. 193.—LUDWIG 1889—92, p. 331.—BELL 1892, p. 51.—KOEHLER 1895*a*, p. 48.—KOEHLER 1896, p. 108, figs. 33—35.

Bathyplotes tizardi ÖSTERGREN 1896, p. 354.—LUDWIG 1900, p. 138.—PERRIER 1902, p. 350—352.

Herpysidia tizardi PERRIER 1898, p. 1665.—PERRIER 1899, p. 247.

Specimens examined :—

Sci. Coll., Spec. No.	No. of individuals	Preservation	Size in cm.	Locality	Depth in *hiro*	Collector	Date
1064	1	Alc.	11.8 × 2.5	Okinosé, outer edge, Iwado-line, Sagami S.	550	Aoki	Feb. 2, 1896.
1065	1	„	8.5 × 2.5	Homba, Sagami S.	400	„	May 2, 1896.
1455	1	Formal.		Okinosé, inner edge, Sengenzuka-line, Sagami S.	400	„	Dec. 10, 1899.

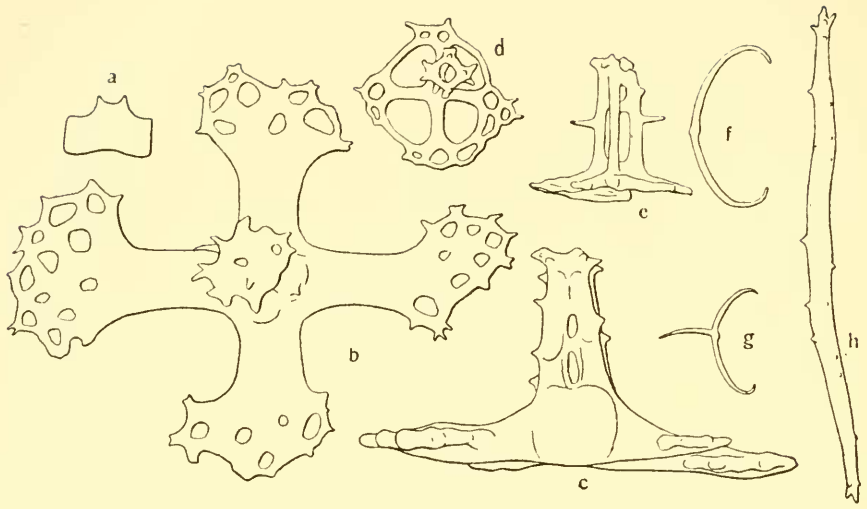
Description :—" Body elongate, equally rounded at each extremity, flattened. Mouth ventral, with twenty yellow tentacles. Anus subdorsal. Dorsal surface with conical processes, few in number, of equal size, the largest measuring 5 to 10 mm. in length; those processes which attain a greater size are thinly placed on or in the neighbourhood of the two dorsal ambulacra, while the smaller are to be found partly in very limited numbers scattered among the larger, partly more crowded, forming a simple row along the sides of the body and round its anterior extremity. The pedicels probably form a double row along each lateral ventral ambulacrum, but on the odd ambulacrum, marked out by a deep furrow, I could not convince myself of the presence of any such appendages. The calcareous ring is very reduced, in the larger specimens absent. Two genital bundles, one on each side of the dorsal mesentery. A single Polian vesicle and madreporic canal. Body-wall thick, strengthened by C-shaped bodies and tables. In some parts of the body the spires grow much larger, and possess much more numerous transverse beams ; in others all the tables become very robust, with a greater number of holes in the highly dilated ends of the arms, and with the spire more irregularly developed and highly spinous. As a rule, the four rods which constitute the spire are almost parallel and provided with spires.

The dorsal processes carry numerous spinous rods and tables with very long spires." (Théel 1886, p. 193).

Remarks :—Color in alcohol white, while in the formalin specimen the pale pink color is still retained. The body wall is comparatively thin and the five radial muscles are recognizable from outside.

The appearance of the animal when living seems to be different from its present condition. Aoki described it from the first specimen captured as follows :—" The body was very thin and flat, and made peculiar twisting or rotating movements as it glided on in the vessel. Color was that of a peach blossom (deep pink). Its length was about twice what it is now."

On the ventral surface the median unpaired ambulacrum is entirely naked. Each lateral ambulacrum showed two rows of pedicels generally alternate in position. These cease to exist a short distance from the edge of the mouth. The outer row runs somewhat (3 mm.) within the lateral border on the ventral surface. A closely set single row of small papillae is placed on the body margin between the dorsal and ventral surfaces. The row goes around the anterior edge of the body in front of, and dorsal to, the ventrally placed mouth. Posteriorly the row passes below the subdorsally placed anus. The number of these papillae on one side (from the anterior to the posterior median point) is about 60. In their present state, the papillae are only about 1.5 mm. high. Papillae on the dorsal surface proper are rather scattered and larger than those of the edge. Although they are most numerous and largest on the two dorsal ambulacra, there are some smaller ones scattered on the interambulacra. There are three or four specially large ones near the anterior end behind the marginal row of papillae and also near the posterior end. These seem to



Textfig. 8.

Bathyplotes tizardi: *a*-Radialia of calcareous ring; *b*, *c*—Tables from posterior region; *d*, *e*—Same of ventrum; *f*, *g*—C-shaped bodies; *h*—Supporting rod. (*b*—*h* × 300).

have a rather large mamma-shaped base, from the top of which a slender papilla arises. These slender parts are 5—6 mm. long in their present contracted state.

Mouth ventral; anus subdorsal or terminal. Tentacles 18, sometimes only 15. Genital bundles two. Polian vesicle one, large and long (1 cm.). In one specimen I made out radialia in the calcareous ring to be of the shape shown in textfig. 8 *a*. Interradialia and stone-canal not made out. Longitudinal muscles undivided.

The calcareous deposits consist of cross-shaped tables and C-shaped bodies together with supporting rods. The tables in the posterior parts of the body are very robust and thick, measuring 0.17—0.23 mm. in diam. (*b*, *c*). They are rarely five-radiate. Spires thick and short, and have a crown-like enlargement, which in some cases seem to be without any central opening. The tables of the ventral surface are ordinarily the smallest in the

whole body (0.06—0.07 mm. in diam.), many of them having one or more cross arms united at the ends and thus presenting a more or less complete disk-like shape (*d*, *e*). End-plates are well developed in pedicels: they are small in papillae. Numerous C-shaped bodies (*f*, *g*) are found in the layer below that of the tables (0.08 mm. in largest diam.). They are also present in an immense number in the cloacal wall, and to some extent in the tentacular wall. The bent, toothed or smooth supporting rods (*h*) are found in large numbers in the wall of both pedicels and papillae (0.48 mm. long.).

It seemed to me very remarkable that the present species which has hitherto been found exclusively on the Atlantic coasts of Europe and Africa, should be found here in Japan. I therefore made a very thorough and careful examination to see if the Japanese specimens did not present some features different from *B. tizardi*. But I could not find a single point which would justify me in putting them in another species or in establishing a new species for them. At the same time, I should like to call attention to the remarkable similarity which a species described recently by SLUITER (*Bathyplotes rubicundus*) presents to my specimens as well as to the description of *S. tizardi*. Should that SLUITER's species turn out to be identical with the one under treatment, an intermediate station is established for the species, and the occurence of it in Japanese waters may not seem so out of place.

Locality:—Faröe Channel (THÉEL '82); Bay of Biscay (KOEHLER '95, '96); Bergen (ÖSTERGREN '96); Along the Atlantic coast of Morocco, Sahara, Senegal (PERRIER 02); Sagami Sea.

Genus **Mesothuria** Ludwig 1894.

10. *Mesothuria deani*, sp. n.

(Textfig. 9).

Specimens examined :—

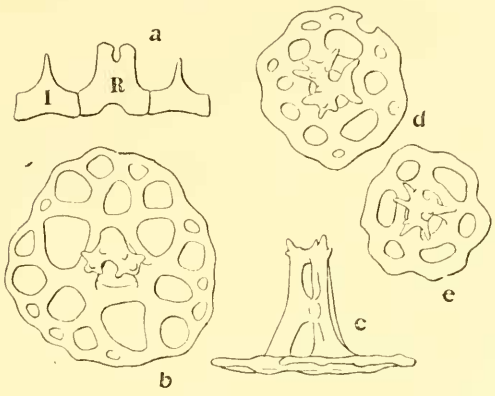
Sci. Coll., Spec. No.	No. of individual	Preservation	Size in cm.	Locality	Depth in *hiro*	Collector	Date
1068	1	Alc.	8×1.4	Okinosé, outer edge, Iwado-line, Sagami S.	350	Aoki	Apr. 12, 1897.
1076	1	„		Ōshima, Izu.	350	„	Nov. 4, 1898.
1467	1	Formal.	7×1.6	Nishi-no-Yodomi, Sagami B.	300	„	Jun. 16, 1901.
1478	1	Alc	8×2.3	Uraga Channel (Nakazé, east of Numa, Tateyama B. Takeyama in line with Amezaki).	340	Mitsukuri & Aoki	Aug. 13, 1903.

Description :—Body almost cylindrical. No marginal border. Skin much rumpled and full of creases. Color at present deep brown, probably purple or violet in life-time. Mouth distinctly ventral, anus terminal.

Ambulacral appendages distributed uniformly over the whole body. Pedicels on lateral ambulacra larger than those in other parts of the body, forming three or four irregular rows. The middle parts of the ventral surface with smaller pedicels, which in some specimens could be easily recognized, but were in one specimen so minute that I thought for a long time they were here entirely absent. Dorsal surface with small pedicels (1.04×0.32 mm.) scattered all over the ambulacra as well as the interambulacra.

Genital bundle one on the left. Calcareous ring as in textfig. 9 *a*. Polian vesicle one, 9 mm. long. No tentacular ampullae.

The animal in life clothes itself with sand grains, small shells and shell fragments, which adhere by action of its numerous pedicels.



Textfig. 9.

Mesothuria deani: *a*-Calcareous ring; *b*, *c*—Tables of ventral perisome; *d*, *e*—Same of pedicel. (*c*—*e* × 225). I—Interradialia; R—Radialia.

With the exception of endplates which are found on the ends of the small dorsal, the large lateral and small ventral pedicels, there is only one kind of calcareous deposit, viz., the tables (*b*—*e*). In the ventral perisome, the tables measure from 0.07 to 0.10 mm. in diam., and their spire 0.05 mm. in height. Spire consists almost always of three pillars. It has generally only one crossbeam. The crown has several teeth on the top of each of the three pillars. No elongated diverging ends to the pillars as in some species. Tables on the pedicels not different in shape, but smaller in size, the disks measuring 0.05—0.07 mm. in diameter. No supporting rods.

Remarks:—The fact that these specimens are without any tentacular ampullae and that their two-branched respiratory tree does not intermingle with the blood vessels of the alimentary tract, at once puts them in the sub-family Synallactinae; and the presence of only one genital bundle on the left side makes them referrable to the genus *Mesothuria*. Even in the narrowed definition of the genus given by Perrier, the presence of pedicels on the odd ventral ambulacrum fits them to that genus. The specimens have tables of the triradiate type and are very close to *M.*

maroccana PERRIER, but the tables in that species of PERRIER have the disk showing either six holes only, or two or three more holes of the primary circle in addition, but never any outside that circle. *M. murrayi* (THÉEL) is also very near our species, but in that species large lateral pedicels exist in a single row on the outer edge of each lateral ambulacrum, other pedicels of the zone being small. Besides, the shape of the spire of the tables is different: it terminates in three long prongs garnished with teeth, while in our species there is no such long prong.

I believe, *M. murrayi* var. *parva* (THÉEL) comes closest to the present species, but the general configuration of the body in that form is almost lozenge-shaped, while in the latter it is more uniformly broad and longer. Moreover, the pedicels of the median ventral surface are minute and almost invisible to the naked eye, while in my species they are, although small, yet very distinct, numerous and easily seen. Finally, the tip of the pillars in the tables is provided with many teeth in *parva*, while in my species it has generally only three or often even a smaller number of teeth. The color of the former species is said to be yellowish white, while that of the latter is purple or violet. The present species is also somewhat near *M. holothurioides* SLUITER, but that species has the middle part of the ventrum entirely naked.

There seems therefore nothing to do but to constitute this into a new species. I therefore name the species for Dr. BASHFORD DEAN of Columbia University, New York, who joined us for a time in the study of the fauna of Sagami Bay.

Subfamily 2. Holothuriinae.

Genus **Mülleria** Jaeger 1833.

Tentacles 20, sometimes more. Ventrum flat, dorsum arched. Ambulacral appendages in the shape of pedicels on the ventrum and of papillae on the dorsum; their arrangement in longitudinal series seldom visible. A single genital bundle on the left side of the dorsal mesentery. No C-shaped deposits in the perisome. Anus surrounded by five calcareous teeth.

Within the limits of the Japanese empire, the species of the genus are confined to the subtropical region, *viz.*, to the Liu-Kiu and the Ogasawara (Bonin) Islands.

The five species found within the limits of the empire may be distinguished as follows :—

I. Tentacles 25 ..... *mauritiana.*

II. Tentacles 20. Among calcareous deposits there are :

1. Hollow ellipsoids ..... *maculata.*
2. Rather plump rosettes ..... *echinites.*
3. X-shaped rods and rosettes.
   - *a.* Ventrum white, and its continuation forms a light gray area round the anus ..... *lecanora.*
   - *b.* Dorsum and the area around the anus uniform in color ..... *miliaris.*

11. *Mülleria echinites* Jaeger.

Mülleria echinites Jaeger 1833, p. 17, Taf. III., Figs. 3,6;—Selenka 1867, p. 312;—Semper 1867—'68, pp. 76, 276, Taf. XXX., Fig. 8;—Ludwig 1882, p. 134;—Lampert 1885, p. 99;—Théel 1886 *a*, p. 201;—

Ludwig 1889—'92, p. 329;—Ludwig 1887*b*, p. 1223;—Sluiter 1894, p. 104;—Lampert 1896, p. 59;—Whitelegge 1896, p. 160;—Ludwig 1899, p. 557;—Sluiter 1901, p. 24.

Actinopyga echinites Kent 1893, p. 236;—Bedford 1899, pp. 835, 836.

Specimens examined:—

Sci. Coll., Spec. No.	Number of individuals	Preservation	Locality	Collector	Date	Names in market
1186	1	Alc.	Sakibaru, Naha, Liu-Kiu.	Mitsukuri, Ikeda and Yasuda.	Apr. 7, 1901.	
1020	1	Cured	Liu-Kiu Is.			"Chirimen"
1307—1309	3	Dried	Torres Strait.			Red fish (紅靴)
1310	1	„	„			Black fish (烏參)

Description:—Tentacles 20. Ventrum flat; dorsum convex, transversely rugose. Calcareous deposits of branched rods (according to Théel, small incomplete rosettes and large simple or irregularly branched rods, both having dichotomous ends to the arms, there being transitional forms between the two). Mouth slightly ventral, anus slightly dorsal. Color dark chestnut brown on the dorsum, lighter and clear chestnut color on the ventrum.

Remarks:—The first specimen (No. 1186) seems to agree best with the descriptions and figures of the species. There are two kinds of calcareous bodies: (i) simple or irregularly branched rods dichotomously branching at the ends, and (ii) somewhat smaller incomplete rosettes. There are, however, transitional forms between the two. The size of the specimen when fresh, 13.5×6.5 cm.; of a chestnut color, dark on the dorsal and lighter on the ventral surface. Three longitudinal rows of pedicels distinguishable. Dorsal papillae not many, with end-plates. The specimen was

captured near the low-water mark among dead corals, at Sakibaru, Naha, Liu-Kiu Is.

One of the specimens, cured for the market (No. 1020), I refer to this species. It is known by the name of "Chirimen," the natives not distinguishing between this and *M. miliaris*.

Locality:—Zanzibar (Lampert '96), Bueni (Lampert '96), Tumbatu (Lampert '96); Seychelles (Lampert '85, Ludwig '99); Indian Ocean and Padang (Ludwig '82); Ceylon (Ludwig '87); Saleh Bay and Saleyer (Sluiter: 01); Celebes (Jaeger '33, Lampert '85); Fiji (Théel '86); Thursday I. (Sluiter '94); Amboina (Sluiter '94); Funafuti (Whitelegge '97); Great Barrier Reef (Kent '93); Rotuma (Bedford '99); Torres Strait; Liu-Liu Is.

12. *Mülleria lecanora* Jaeger.

(Pl. III., figs. 21—22).

Mülleria lecanora Jaeger 1833, p. 18, Taf. II., Figs. 2—2*b*, Taf. III., Fig. 8.

Holothuria (Microthele) dubia Brandt 1835, p. 54.

Actinopyga lecanora Bronn 1860, p. 403;—Kent 1893, p. 235; Bedford 1899 *a*, p. 149.

Mülleria lecanora Selenka 1867, p. 312;—Semper 1867—'68, pp. 75-76, 276, Taf. XXX., Fig. 7, Taf. XXXIII., Figs. 10-11, Taf. XXXV., Fig. 2, Taf. XXXVI., Fig. 15, Taf. XXXVII., Fig. 14, Taf. XXXIX., Figs. 4-6; —Haacke 1880, p. 46;—Ludwig 1881, p. 592;—Ludwig 1882, p. 134;—Ludwig 1883, p. 165;—Lampert 1885, p. 100;—Théel 1886 *a*, p. 200;—Sluiter 1887, p. 203;—Ludwig 1887 *b*, p. 1223;—Ludwig 1889—'92, p. 329;—Sluiter 1894, p. 104;—Sluiter 1895, p. 79;—Mitsukuri 1896, p. 412;—Sluiter 1901 *b*. p. 23.

Holothuria dubia Selenka 1867, p. 331;—Semper 1867—'68, pp. 92, 279.

Specimens examined :—

Sci. Coll., Spec. No.	Number of individuals	Preservation	Locality	Collector	Date
1187	1	Alc.	Itoman, Okinawa.	A diver	Apr. 10, 1901.
1203	1		Kiamuzaki, Okinawa.	,,	Apr. 12, 1901.
1316	1	Dried	Liu-Kiu		
1001	3	Alc.	Okinawa		
1003, 1015, 1016, 1170, 1171.	5	Cured	Okinawa (3 of them from Yayeyama Is.)		

Description :—Tentacles 20. Body cylindrical, about a foot long, the ventral surface flat; the dorsal, convex. Anterior extremity slightly attenuated. Feet less frequent on the dorsal than on the ventral surface. The ventral surface ashy white, ornamented with grayish brown spots and rings around the base of pedicels. Dark brown lines dividing the surface into small squares most conspicuous on the sides. Dorsum coffee-brown, with many irregular angular lighter spots. The region around the anus as light colored as the ventral. The line dividing the ventral coloration from the dorsal, irregular, broken, marked with angles. Mouth slightly dorsal. Anus slightly inferior.

The ventral pedicels in three distinct rows in the young. The papillae of the dorsum extraordinarily long and longer than in any holothurian (SEMPER). Calcareous bodies small, X-shaped, branched as occurs often in the species of *Stichopus* and *Mülleria*, comparatively few in number. Polian vesicle and stone-canal one each. With or without Cuvierian organs. The color of the dorsal surface is always well defined from that of

the ventral; and a lighter colored area always present around the anus.

Remarks:—One of the sepcimens in the fresh state was probably about 30 cm. long. In alcohol it is much contracted and measures 14×10 cm.

I have the following notes on a fresh specimen. Dorsum; purplish black with large, irregular, cloud-like, yellow patches, generally transverse in direction. These are most numerous on the two dorsal ambulacral zones. A few pedicels on these lines. More laterally there are finely indented grayish patches. Ventrum white. Pedicels most numerous on the median and the two lateral ambulacral zones. The lighter ventral area extends up to and surrounds the anus, becoming somewhat gray in this part.

All the alcoholic specimens are much distorted in shape. One which shows least distortion measures 14.5 cm. by 6.5 cm. Dorsum chocolate-brown. Ventrum much lighter; toward the sides dark lines bounding small quadrilateral areas. The light ventral color extends into the area around the anus, which is also more or less distinctly marked into small quadrilateral areas. The boundary line between the dark dorsal and the light ventral areas is very irregular and broken; marked out into quadrilateral areas of a lighter color, partly corresponding to the yellow patches of the fresh specimen, and partly to the gray patches. In some specimens the marking extends over the dorsal surface. Tentacles 20. Mouth slightly ventral, anus slightly dorsal.

Small X-shaped calcareous bodies with the ends of the crossed pieces dividing dichotomously about three times, looking like the tendrils of a climbing plant. In many cases there is in the middle of the middle piece a small branch on one side.

This species is cured for market as dried trepang (Pl. III., figs. 21—22) and then is known as "Shee-bee" (Cypræa-like).

Locality:—Celebes (JAEGER '33); Ogasawara Is. (BRANDT '35); Philippines (SEMPER '67—'68); Timor (LUDWIG '82); Mauritius (HAACKE '80, LUDWIG '83, THÉEL '86; Zebu (LAMPERT '85); Tongatabu (THÉEL '86); Fiji (THÉEL '86); Amboina (SLUITER '94, '95); Ceylon (LUDWIG '87); Java (SLUITER '87); Great Barrier Reef (KENT '93); Saleyer (SLUITER: 01), Karakelang I. (SLUITER: 01), Elat (SLUITER: 01); Liukiu Is.

13. *Mülleria maculata* (BRANDT).

(Pl. III., figs. 23–24; textfig. 10).

Holothuria (*Microthele*) *maculata* BRANDT 1835, p. 54.

Mülleria nobilis SELENKA 1867, p. 313, Taf. XVII., Figs. 13—15;—SEMPER 1867—'68, pp. 76, 276, Taf. XXXVII., Figs. 9—12;—SEMPER 1869, p. 120;—THÉEL 1886 *a*, p. 198.

Holothuria maculata SELENKA 1867, p. 331;—SEMPER 1867—'68, pp. 92, 279.

Mülleria maculata LUDWIG 1881, p. 593;—LAMPERT 1885, p. 97;—LUDWIG 1889—'92, p. 329;—LUDWIG 1899, p. 557.

Specimens examined:—

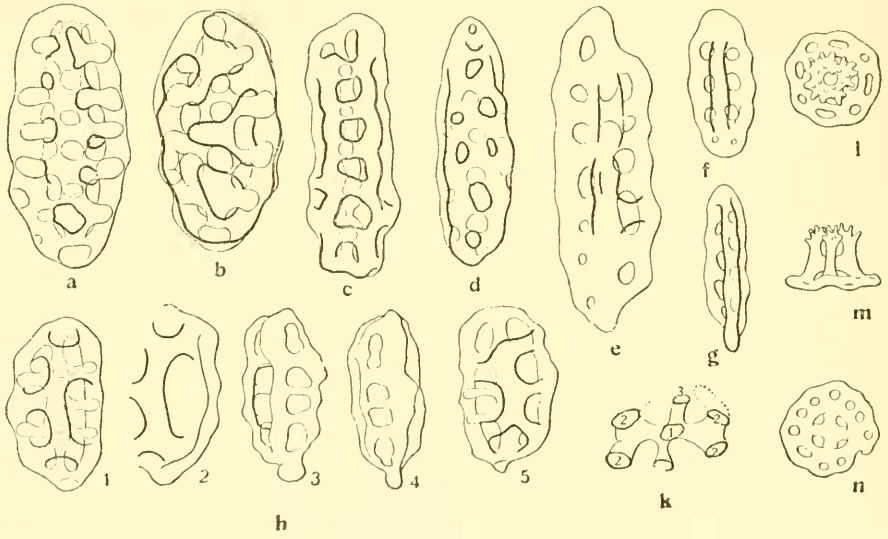
Sci. Coll., Spec. No	Number of individuals	Preservation.	Locality	Collector	Date	Names in market
1151—1152	2	Cured	Okinawa, Liu-Kiu.			"Kuro-Usā"
1019	1	„	Yayeyama Is., Liu-Kiu			"Kuro-Usā"
1014, 1018, 1172.	3	„	Okinawa			"Shiro-Usā"
1013	3	„	„			

Sci. Coll., Spec. No.	Number of individuals	Preservation	Locality	Collector	Date	Names in market
1289	1	Alc.	Ōgiura, Chichijima, Ogasawara Is.	Yoshiwara	Summer of 1901	
1303—1305	3	Dried	Torres Strait			Teat fish (石參) & white teat fish (白靴)
1311	1	,,	,,			Black snake (烏双蟲)
1313—1314	2	,,	(Purchased at Hongkong Market)			

Description:—Tentacles 20. Papillae on the dorsal surface; pedicels on the ventral surface, both numerous. Calcareous deposits alike in the dorsal and the ventral perisome. The outer layer consists of robust, rather sparsely scattered tables with a smooth disk 0.06—0.08 mm. in diameter, and a spire terminating in 16—20 teeth. The thick lower layer consists of closely packed, hollow, fenestrated ellipsoids, 0.07 mm. long, and with four rows of four openings each, sometimes with a central axis-like rod piercing through the middle. Color plain black, or having on a coal-black ground 5—7 snow-white transverse spots on the sides and a circle of smaller white spots on the dorsum. There exist all intermediate shades of coloration between these two extremes. Calcareous ring conically narrowed in posterior direction. Interradialia about half as high as radialia, which are three-pointed. Cuvierian organs in bundles of 5—10, at the base of right respiratory tree. Tentacular ampullae very large.

Remarks:—The tables (textfig. 10, *l*—*n*) are quite stout, with a more or less complete circle of holes around the large central one. Only one cross-beam. The spire ends in a number of teeth. Of the ellipsoids, Selenka says (loc. cit.) that they are "zusammengedrückten hohlen, von viermal vier Löchern durchbohrten Kalkellipsoiden von 0.07 mm. Länge, zuweilen von einem

mittleren Stabe durchsetzt." A careful study of these ellipsoids obliges me to differ from SELENKA in the details. A detailed study under a higher power shows that they are not as regular as represented in SELENKA's figs. 15 and 15′. If, with a dull point of needle, pressure is brought to bear on the cover-glass not long after a preparation of the ellipsoids is made in canada-balsam, the ellipsoids begin to roll about on their axes, and one is then able to get a glimpse of all their sides. Textfig.



Textfig. 10.

Müllería maculata: *a*—Common and regular type of ellipsoids; *b*—Irregular type; *c*—Side view of an ellipsoid; *d*—Side view of another ellipsoid with a double row of holes in the middle part; *e*—*g*—Simple types; *h* 1—5—Different views of an ellipsoid seen while rotating about its longitudinal axis; *k*—Transverse section of an ellipsoid: 1—central rod, 2—paired rods at each edge, 3—rods running in the middle of the two broad surfaces; *l*—*n*—Tables. (*a*—*k*, ca. × 300; *l*—*n*, × 200).

h 1—5 show sketches of an ellipsoid in various aspects, made as it rolled about. In fig. *h* 1 we observe one side. The arches on that side (as delineated by heavy lines) are irregular. As it rolls from left to right, it begins to show its left edge (fig. *h* 2),

and somewhat to our surprise, that edge reveals itself as double. In fig. *h* 3, a part of the surface shown in fig. *h* 1 and the edge-surface are shown. This shows that the middle arch is connected with the rod which passes through the axis of the ellipsoid by bars (numbering three in this particular case). Fig. *h* 4 shows the full view of the edge surface. The edge is double and is pierced by a series of four holes. Fig. *h* 5 is the reverse of that surface represented in fig. *h* 1, and shows that the arches here are again irregular and in no way correspond with those of the opposite side. I was able to obtain sections of these ellipsoids by imbedding and cutting them in celloidin. Fig. *k* is one of these sections; it shows many features visible in fig. *h*. There are in all seven rods which serve as supports of the ellipsoid, viz., (1) the central rod, (2) a pair at each edge, and (3) one in the middle of each of the two broader surfaces. These rods are connected with one another by a series of cross-bars. The middle rod of each broad surface is connected with the central axial rod by a series of three crossbars (see textfig. *h* 1 and 3). The two lateral rods on each side are connected with each other by three crossbars, making a series of four holes in all; and strange to say, the same rods, instead of each being connected separately with the central rod, are united by a V-shaped piece with each other as well as with the latter (textfig. *k*). The parts indicated with dotted lines in that figure show portions of the irregular arches which connect the central rod with the edge rods. Textfig. 10*a* shows the surface view of another ellipsoid. This is one of those which are perhaps of the most common type, the arches on the surface shown being more or less regular. The middle piece has a series of four more or less symmetrical openings (shown by heavy lines) on each side. A series of four

crossbars (shown by faint circles) connects it with the central rod. The edge pieces are connected with the axis by five crossbars which are in the level of the openings of the upper surface. The openings between these crossbars are therefore alternate with those of the upper surface. Textfig. 10*b* is one of those which are very irregular. Textfigs. 10 *c* and *d* show the edge of two different ellipsoids. In the textfig. 10 *d* there is a departure from the common type in that the openings in the middle are paired instead of all being single. Textfigs. 10 *e*—*g* are from an individual which shows many of the ellipsoids to be of a very simple structure. Here we have to do with ordinary buttons with ridges on the middle piece. In *e*, there are two such ridges and from one of them an arch goes over to one side. Such cases seem to show that the ellipsoids are derived from buttons, but exactly how these are modified, it is hard to say. It seems probable that the middle piece of the button becomes the central rod of the ellipsoid. On each side of the middle piece ridges, or rather series of arches, are raised ; then these are connected by lateral pieces with the edges. So far it seems very plain ; but how the double edges of the ellipsoid are formed is not quite clear. If the edges of the cross-pieces unite with each other and form an edge on each side of the original button, there should be two series of openings instead of one. It is possible that at first they are double and afterward run together into one in the middle. The two paired openings on the edge, shown in textfig. 10 *d*, seem to point in this direction.

This species is also cured for the market and exported to China. In the prepared state there seem to be two varieties, probably due to the differences in the color of the living animal. They are known under the names of "Shiro-Usā" (Pl. III., fig. 23) and "Kuro-Usā" (Pl. III., fig. 24). Their value seems to range from

150 to 160 *Yen* per hundred *Kin*.* A variety of "Shiro-Usā" without prominent lateral papillae, is known as "Aoba."

Locality:—Zanzibar (Selenka '67); Mauritius (Möbius-Haacke '80); Kosseir (Lampert '85); Celebes (Lampert '85): Philippine Is. (Semper '67—'68); Guam Is. (Brandt '35); Sandwich Is. (Selenka '67); Fiji Is. (Théel '86); Torres Strait; Liu-Kiu; Ogasawara Is.

14. *Mülleria mauritiana* (Quoy & Gaimard).

(Pl. III., figs. 25—27; textfig. 11).

Holothuria mauritiana Quoy & Gaimard 1833, p. 138.

Mülleria mauritiana Brandt 1835, p. 74.—Selenka 1867, p. 315.—Selenka 1868, p. 116.—Semper 1867—68, pp. 76, 276.—Semper 1869, p. 120.—Haacke 1880, p. 46.—Ludwig 1882, p. 134.—Ludwig 1883, pp. 157, 165.—Bell 1884, p. 510.—Lampert 1885, p. 98, Taf. VII.—Théel 1886*a*, p. 201.—Sluiter 1887, p. 199.—Ludwig 1887*a*, p. 32.—Bell 1887*a*, p. 140.—Ludwig 1888, p. 812.—Lampert 1889, p. 813.—Ludwig 1889—92, p. 329.—Koehler 1895*c*, p. 380.—Sluiter 1895, p. 7.—Lampert 1896, p. 59.—Ludwig 1899, p. 557.

Mülleria varians Selenka 1867, p. 310, Taf. XVII., Figs. 4—9.

Actinopyga mauritiana Bell 1887*b*, p. 653, Pl. XXXIX., Fig. 1.—Kent 1893, pp. 229, 236.—Bedford 1899*b*, p. 835.

Actinopyga (*Mülleria*) *mauritiana* Bedford 1899*a*, p. 149.

Specimens examined:—

Sci. Coll., Spec. No.	Number of individuals	Preservation	Locality	Collector	Date
1005—1008	4	Alc.	Ogasawara Is.	Hirota & Sekiguchi	Mar.—Apr., 1894.
1009—1010	4	,,	Okinawa, Liu-kiu.		
1041	1	,,	Naha, Okinawa.	Kuroiwa	

* 1 *Kin* = 650 grams.

Sci. Coll., Spec. No.	Number of individuals	Preservation	Locality	Collector	Date
1200	1	Alc.	Naha, Okinawa.	Miyajima	May 25, 1900.
1198	1	,,	Okinawa Is.		
1011, 1099	6	Cured	,,		
1150	2	,,	,,		
1173—1175	3	,,	Ogasawara Is.		
1185	1	Alc.	Inanze, Naha, Okinawa.	Mitsukuri & Ikeda	Apr. 18, 1901.
1336	1	,,	Kōbi I, Sakishima, Ogasawara Is.	Miyajima	May 15, 1900.
1290	3	,,	Ōgiura, Chichijima, Ogasawara Is.	Yoshiwara	Summer of 1901.
(Agas.) 7*b*	1		Fakarava, Paumotu.	A. Agassiz	Oct. 12, 1899

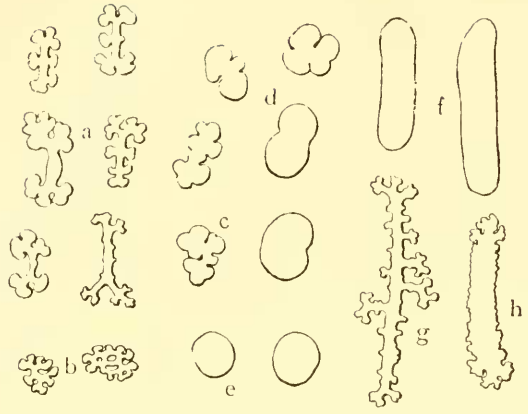
Description ;—Tentacles 25. Dorsal surface convex with a few pedicels ; ventral surface flat with numerous pedicels. In the dorsal integument longer and shorter calcareous rods with small processes running out from the sides, and with the ends spinous, or more or less distinctly dichotomous ; in the ventral perisome small, smooth, oval grains and larger, smooth, unbranched rods with slightly rough ends ; in the muscles and in all the viscera small smooth rods. Polian vesicle single. Stone-canal attached to the mesentery. In the calcareous ring the four-pointed radialia are often enlarged at the expense of the two-pointed interradialia.

Remarks :—The largest alcoholic specimens measured 15×4 cm. or 15×5 cm. Color in alcohol chocolate brown to black on the dorsal surface ; much lighter on the ventral. Bases of the dorsal papillae very frequently surrounded by white ring. In some

individuals these rings formed white patches, which were most conspicuous along the sides and around the cloaca, sometimes turning into white the prominent color of these regions or even of the whole dorsum. In other individuals, the rings were confined to a few papillae along the sides or around the cloaca.

Tentacles 25—27 (two individuals from Ogasawara Is. had 25 and two others 27). Another smaller individual from the same locality had only 20. Whether this was due to some tentacles having been lost, or to the young individual not having a full complement, could not be ascertained.

Calcareous deposits in the dorsal perisome: (i) numerous slender elongate rods with short, mostly simple, occasionally slightly branched processes along their sides, and with a tendency to divide dichotomously at the ends (textfig. 11 *g*). Length 0.04—0.13 mm., breadth 0.004—0.007 mm. (ii) Incomplete rosettes, 0.034—0.02 mm. across (*b*). In the ventral perisome: (i) Elongate rods, in general shorter but thicker than those in the dorsal perisome. In some the margin is smooth (*f*), in others it is beset with fine close-set processes, making it serrate (*h*); in still others, there are along the margin well marked processes, some of which may even be branched (*g*). The ends of the rods are almost always more or less rough, and sometimes bifid. The two ends are very often different. There are all stages of gradation between these various forms. Size varying between 0.12×0.018 mm. and 0.044×0.012 mm. (ii) Oval grains, sometimes regularly oval (*e*), sometimes more or less irregular or biscuit-shaped, being pinched in the middle (*d*); sometimes aggregations of small lobes, approaching the rosettes (*c*). The longest oval grains and shortest rods can not be distinguished. Length and breadth 0.04×0.02—0.02×0.014 mm. (iii) Rosettes (*a*), much



Textfig. 11.

Mülleria mauritiana:—*a*—Rosettes of ventrum; *b*—Same of dorsum; *c*—*e*—Oval grains; *f*—Smooth rods; *g*—Rod with branched processes; *h*—Rod with serrated margin. (×300).

thicker than those of the dorsal perisome, and not so regular. All stages of transition exist between these and the lobed oval grains. Not as numerous as the elongate rods or oval grains. In the peritoneum also there are calcareous deposits. These are slender, generally more or less curved rods of a uniform size. Their margin is often smooth, but quite as often somewhat rugged, especially toward the ends (0.068×0.006—0.048×0.007 mm.).

Calcareous ring consists of large pieces.

This species is also cured for market and exported. It is the form known in commerce as "Zōri-geta" (Pl. III., figs. 25—27). Its value is 60—70 *Yen* per 100 *Kin*.

Locality:—Mauritius (Quoy & Gaimard '33, Möbius—Haacke '80, Ludwig '83); Mozambique (Bell '84); Amirante Is. (Bell '84); Darros Is. (Bell '84); Querimba (Semper '69); Red Sea (Semper '69); Assab (Ludwig '87); Zanzibar (Lampert '95); Seychelles (Lampert '85, Ludwig '99); Kosseir (Lampert '85); Natal Bay (Lampert '85); Ceylon (Bell '87); Java (Ludwig '82, Sluiter '87); Padang (Ludwig '82); Pulo Penang (Ludwig '83, Théel '86); Pulo Edam (Ludwig '88); Andaman Is. (Bell '87); Sunda Is. (Koehler '95); Karakelang Is. and Bay of Pidjot (Sluiter: 01); Luzon (Semper '67); Amboina (Ludwig '82); Sandwich Is. (Selenka '67); Fiji Is. (Selenka '67); Samoa (Semper '69); Society Is (Selenka '67); Tahiti (Théel '86); Marquesas (Théel '86); Paumotu (Théel '86); Fooa (Théel

'86); Great Barrier Reef (Kent '93); Lucipara Is. (Lampert '89); Bueni I. (Lampert '96, Bedford '99); Liu-Kiu; Ogasawara Is.

15. *Mülleria miliaris* (Quoy & Gaimard).

(Pl. III., figs. 28—29; textfig. 12).

Holothuria miliaris Quoy & Gaimard 1833, p. 137.

Holothuria lineolata Quoy & Gaimard 1833, pp. 137—8.

Mülleria miliaris Brandt 1835, p. 74.—Selenka 1867, p. 314.—Semper 1867—68, pp. 76, 276.—Selenka 1868, p. 117.—Ludwig 1880, p. 7. —Haacke 1880, p. 46.—Ludwig 1882, p. 134.—Ludwig 1883, p. 165.— Lampert 1885, p. 99.—Théel 1886*a*, p. 200.—Ludwig 1887*b*, p. 1223. —Bell 1887*b*, p. 144.—Ludwig 1888, p. 812.—Ludwig 1889—92, p. 329. Sluiter 1894, p. 104.—Sluiter 1895, p. 79.—Ludwig 1899, p. 557.— Sluiter 1901 *b*, p. 23.

Mülleria lineolata Brandt 1835, p. 74.—Selenka 1867, p. 314.

Mülleria plebeja Selenka 1867, p. 312.

Actinopyga miliaris Bell 1887*a*, p. 653, Pl. XL., Fig. 1.—Bell 1888, p. 389.

Specimens examined :—

Sci. Coll., Spec. No.	Number of individuals	Preservation	Locality	Collector	Date
1197	1	Alc.	Sokari, Amami-Ōshima, Ōsumi.	Mitsukuri	Mar. 30, 1901.
1048	1	,,	Okinawa Is. (?)		
1020	1	Cured	,, (?)		
	1	Alc.	Ogasawara Is.	Ōtake	Oct. 1902.

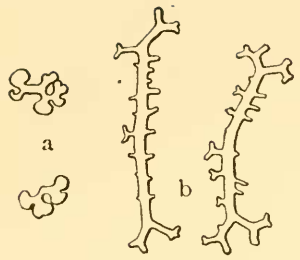
Description :—Tentacles 20. "Die zahlreichen Füsschen des Bauches mehr weniger deutlich in drei Reihen längs geordnet.

Die Kalkkörper der Haut....bestehen in langgezogenen X-förmigen oder stabförmigen Gebilden mit krausen Auswüchsen verziert, auf dem Rücken 0,05 Mm. lang, am Bauche zum Theil viel kleiner. Alle Füsschen besitzen durchlöcherte Kalkscheibchen, in deren Nähe auch noch grössere spärliche Stäbchen liegen. In den Muskeln und allen Eingeweiden sind überall glatte und dünne 0,048 Mm. lange Kalkstäbchen eingestreut.—Körper und Tentakeln einfach chocoladenbraun. Die Thiere, bis 20 Cm. lang, gleichen auch im inneren Bau den Exemplaren von *Müll. Agassizii.* Der Kalkring ist stark verdickt, nach hinten conisch verjüngt; typisch ist das Radiale vier-, das Interradiale einspitzig. Cuvier'sche Organe fehlen. Steincanal einfach, im Mesenterium festgelegt, das Madreporenköpfchen knopfförmig; Poli'sche Blase einfach; Tentakelampullen sehr lang ....." (Selenka 1867, p. 312).

Remarks : —Color in alcohol dark chestnut, slightly lighter on the ventral surface. In the fresh state the first specimen was uniformly dark purplish black on the dorsum as well as on the ventrum. Length 27 cm. and breadth 9 cm. Tough to the touch. The coloration is very markedly different from that of *M. lecanora*; this is the only fact which is decidedly against the idea advanced by Bell that this species should be united with *M. lecanora.* Calcareous ring agrees well with the description. Polian vesicle single. The other specimen shows very nearly the same calcareous bodies.

Even in the alcoholic specimens, the three rows of pedicels are distinctly recognizable. Tentacles 20, large.

Calcareous deposits in dorsum: (i) rather long rods with dichotomous ends and with short growths throughout the length, up to 0.068 mm. long (textfig. 12 *b*); and (ii) much rarer rosettes with tendril-like processes (*a*). In the ventrum, rods are shorter (0.04 mm.) but have lateral growths much closer and longer,



Textfig. 12.
Mülleria miliaris: *a*—Rosettes. *b*—Rods. (×400).

corresponding to the words of SELENKA: "langgezogene X-förmige oder stabförmige Gebilde mit krausen Auswuchsen verziert."

It is not without some hesitation that I refer these specimens to *M. miliaris*. As often remarked by various authors, the diagnoses of the species *M. lecanora*, *M. miliaris* and *M. echinites* are far from being satisfactory. Further and more extensive study is necessary to straighten out the confusion at present existing among these species, which are undoubtedly very closely related. Among the specimens belonging to this group of the genus, I can make out three distinct species. One of these, I am certain, is identical with *M. lecanora*, on account of its characteristic markings and the lighter area around the anus. The other two species may possibly correspond to *M. miliaris* and *M. echinites*, but I am far from being positive on this point. In my opinion, the specimens placed in the above list on the whole correspond best with the descriptions of *M. miliaris*.

When this is cured, it is known as "Chirimen" (=crêpe) from the rumpled appearance of the marketable article (Pl. III., figs. 28—29). It is valued as medicine by the natives of Okinawa Is., and commands the fabulous price of 300 *Yen* per 100 *Kin*. In ordinary markets, it costs about 120 *Yen* per 100 *Kin*.

Locality:—Kosseir (LAMPERT '85); Red Sea (LUDWIG '80); Zanzibar (SELENKA '67, LAMPERT '85); Mozambique (SEMPER '69); Querimba (SEMPER '69); Mayotte I. (SLUITER '95); Madagascar (LUDWIG '83); Seychelles Is. (LAMPERT '85); Mauritius (HAACKE '80, LUDWIG '83); Indian Ocean (LUDWIG '82); Ceylon (LUDWIG '87, BELL '87, '88); Andaman Is. (BELL '87); Pa-

dang (Ludwig '82); W. Coast Binogka (Sluiter : 01); Elat (Sluiter : 01); Atjatuning (W. Coast New Guinea) (Sluiter : 01); Wunoh (N. W. Coast Waigeu) (Sluiter : 01); Saleyer (Sluiter : 01); Kwandang (Sluiter : 01); Sanana Bay (E. Coast Sula besi) (Sluiter : 01); Dongala (Sluiter : 01); Saleh Bay (Dangar besar) (Sluiter : 01); Roma (Sluiter : 01): Timor (Ludwig '82); Zebu (Lampert '85); Amboina (Ludwig '82 '88 Sluiter '94); Tonga & Vanikoro (Quoy & Gaimard '33); New Guinea (Lampert '85); Penope (Théel '86); Fiji (Théel '86); Kyūshū; Liu-Kiu; Ogasawara Is.

Genus **Holothuria** Linné 1758.

16. *Holothuria argus* (Jaeger).

(Pl. III., fig. 30; textfig. 13).

Boladschia argus Jaeger 1833, p. 19, Taf. II., Figs. 1, 1*b*.—Selenka 1867, p. 320.—Bell 1886, p. 27.

Holothuria argus Semper 1867—68, pp. 80, 277, Taf. XXX., Fig. 11. —Ludwig 1882, p. 135.—Ludwig 1883, p. 168.—Lampert 1885, p. 87.—Théel 1886*a*, p. 203.—Bell 1887*b*, p. 653.—Bell 1888, p. 389.—Ludwig 1889—92, p. 329.—Lampert 1889, p. 808.—Kent 1893, pp. 56, 237, Pl. XII., fig. 7.—Koehler 1895*d*, p. 279.—Whitelegge 1896, p. 161.—Sluiter 1901 *b*, p. 12.

Holothuria leopardus Kent 1893, Pl. I., fig. 2.

Specimens examined :—

Sci. Coll., Spec. No.	Number of individuals	Preservation	Locality	Collector	Date
1002	3	Alc.	Okinawa Is.		
1204	3	,,	Sokari, Amami-Ōshima, Osumi.	Mitsukuri, Ikeda &c.	Mar. 29, 1901.
1176	1	Dried	Ishigakijima, Liu-Kiu Is.		

Sci. Coll, Spec. No.	Number of individuals	Preservation	Locality	Collector	Date
1004	1	Dried	Ishigakijima, Liu-Kiu Is.		
1205	1	Alc.	Jishaka Reef, Naha, Okinawa.	Mitsukuri, Ikeda, &c.	Apr. 17, 1901.
1206	1	,,	Kiamuzaki Okinawa Is.	,,	Apr. 12, 1901.
1207	1	,,	Itoman, Okinawa Is.	,,	Apr. 10, 1901.
1208	1	,,	Chinenzaki, Okinawa Is.	,,	Apr. 15, 1901.

Description :—Tentacles 20. Body about a foot long. Ventral surface uniformly brown or dark olive. Dorsum dark gray, here and there lighter; with numerous large, almost black, sharply marked circles arranged more or less in longitudinal rows. Often two or more circles are united so as to form irregular figures. The circles are always surrounded by a whitish space, and are especially black in the margin and in the centre, a papilla arising from the latter point. Calcareous deposits numerous, in the form of more or less complete rosettes. Anus not distinctly stellate. Polian vesicles two. Cuvierian tubes very numerous.

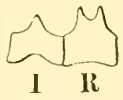
Remarks :—On account of the characteristic markings of the dorsal surface, this is one of the easiest species to identify. It is tolerably common in the Okinawa group and in Amami-Ōshima. The animal lives among coral stocks at a depth of 3—6 fathoms. In the fresh state two individuals measured, when somewhat contracted, 30 cm. in length and 11 cm. in breadth, so that in a fully expanded state they must have been much larger. In alcohol, individuals measure 14—19 cm. in length and 6—11 cm. in width. In life, the dorsum is of an ashy white ground color, and on it are scattered the numerous characteristic circular argus spots 4—7 mm. in diameter. On each of the lines corresponding roughly

to the two dorsal ambulacral zones, these spots are arranged in one, sometimes two, very conspicuous longitudinal rows. The spots on these lines are not quite so circular as those in other parts, but have their outer half flattened. Inside these lines, i.e., in the median dorsal interambulacrum, the argus spots are very thickly distributed, while outside the lines they are much more sparse. Each of the spots is surrounded by a light space. Inside this is a specially dark circle, which, while sharply defined toward the outer rim, shades off gradually toward the centre of the spot. Within the dark ring, the spot is yellowish in color, and finally in the centre there is again a dark spot from which a transparent papilla arises. The size and number of the argus spots vary greatly with individuals. Some have rather small spots close together, while others have larger ones more sparsely scattered. Several of the argus spots may run together and form irregular patches. This is especially the case around the anus. On each of the anterior and posterior halves of the dorsum, mostly confined inside the longitudinal rows of spots, is a large sooty black patch. The ventrum is of the same ashy-white color as the dorsum, and has no argus spots. But in the anterior and posterior halves, corresponding to the sooty black patches of the dorsum, there are two large irregular straw-yellow areas.

There are five groups of 30—50 small yellow papillae around the cloacal opening, which in life is large and of a circular shape. The papillae, which arise from the centre of argus spots on the dorsum, lack the end-plates or have only little ones. In other parts numerous appendages arise; these have end-plates and must be regarded as pedicels. On the ventrum are numerous pedicels much more crowded than those on the dorsum.

In the dorsal perisome, there are very delicate rosettes, some

of which attain a very elaborate figure, dichotomously dividing five times. Others are simple and present the appearance of a more open trelliswork. In the ventral perisome, the calcareous deposits are thicker in structure. Some are simple oval grains. Others are rosettes which present the appearance of more or less oval granules united by delicate bands. This form passes over by gradual transition to the regular dichotomously divided rosettes, but none in the ventral perisome are so delicate as those in the dorsal perisome. Supporting rods are found in the pedicels. There are no end-plates in the papillae, although there are some delicate trellis-like calcareous bodies at the end.



Textfig. 13.

Holothuria argus: Calcareous ring. I—Interradialia. R—Radialia.

Calcareous ring as in textfig. 13. Cuvierian tubes are thrown out in large numbers, and are very sticky; the ends of the threads are pointed, not club-shaped. In each individual, one *Fierasfer* is found.

This species is known in Amami-Ōshima as "Ayami-Shikiri."[1] In Liu-Kiu, it is dried and made into trepangs and is called "Me-haya."[2] (Pl. III., fig. 30). Argus spots are visible in the dried state. The trepangs of this species are worth 17 *Yen* per 100 *Kin*.

Locality:—Seychelles (Lampert '85); Ceylon (Bell '87); Elphinstone Is., Mergui Arch. (Bell '86); Padang (Ludwig '82); Timor (Ludwig '82); Waigeu (Ludwig '82); Celebes (Jaeger '33); Amboina (Koehler '95); Zebu (Lampert '85); Fiji (Théel '85); Funafuti (Whitelegge '97); Samoa (Semper '67—'68); Tahiti (Ludwig '83); Anachoreteninsel (Lampert '89); Bay of Segar, McCluer Gulf, W. Coast New Guinea (Lampert '89); Great Barrier Reef (Kent '93); Roma (Sluiter : 01); Haingsisi (Sluiter : 01)

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(1) *Ayami*, with elaborate figures as in embroidery; *Shikiri*, a holothurian.

(2) *Me*, eyes; *haya*, watching with.

Saleyer Is. (Sluiter : 01); Saleh Bay (Sluiter : 01); Pepela Bay (Sluiter : 01); Labuan Badjo (Sluiter : 01); Kyūshū; Liu-Kiu.

17. *Holothuria atra* Jaeger.

(Textfig. 14).

Holothuria atra Jaeger 1833, pp. 22—23.—Brandt 1835, p. 56.—Selenka 1867, p. 327, Taf. XVIII., Figs. 52, 53.—Semper 1867—68, pp. 88, 250, 278, Taf. XXVI.—Semper 1869, p. 120.—Ludwig 1880, p. 6.—Ludwig 1881, p. 596.—Ludwig 1882, p. 137.—Ludwig 1883, pp. 170—171.—Bell 1884, pp. 509, 510.—Lampert 1885, pp. 85—86.—Théel 1886*a*, pp. 181, 213, Pl. VII., fig. 4.—Bell 1886, p. 28.—Ludwig 1887*a*, p. 32.—Bell 1887*a*, p. 140.—Sluiter 1887, p. 188.—Ludwig 1887*b*, pp. 1227, 1242.—Bell 1887*b*, p. 654.—Bell 1888, pp. 385,389.—Thurston 1890.—Ludwig 1889—92, p. 329.—Kent 1893, pp. 55,121,238.—Sluiter 1894, p. 103.—Sluiter 1895, p. 78.—Koehler 1895*c*, p 382.—Whitelegge, 1897, p. 161.—Lampert 1896, p. 56.—Ludwig 1899, p. 559.—Sluiter 1901*b*, p. 8.

? *Holothuria radackensis* Chamisso & Eysenhardt 1821, p. 352, Taf. XXVI.

Holothuria affinis Brandt 1835, p. 56.—Selenka 1867, p. 331.—Semper 1867—68, pp. 92, 250—251.

Holothuria floridana Pourtalès 1851, pp. 12—13.—Selenka 1867, p. 325, Taf. XVIII., Fig. 47—50.—Heilprin 1888, p. 310, Pl. XIV., figs. 6, 6*a*, 7.7*a*.—Clark 1898, p. 413.—Clark 1899, p. 122.

Holothuria amboinensis Semper 1867—68, pp. 92, 279.—Bell 1884, pp. 509,510.—Lampert 1885, p. 84.

Holothuria atra, var. *amboinensis* Théel 1886*a*, p. 214.—Lampert 1889, p. 813.—Bedford 1898.—Bedford 1899*b*, p. 147.

Specimens examined :—

Sci. Coll., Spec. No.	Number of individuals	Preservation	Locality	Collector	Date
1126	1	Alc.	Chichijima, Ogasawara Is.		
1027	3	,,	,,	Hirota & Sekiguchi	Feb.—Apr. 1895.
1039	4	,,	Liu-Kiu.		
1191	1	,,	Nasé, Amami-Ōshima.	Mitsukuri & Ikeda	Apr. 5, 1901.
1192	1	,,	Sokari, Amami-Ōshima.	,,	Mar. 30, 1901.
1190, 1193	3	,,	Jisakasé, Naha, Okinawa.	,,	Apr. 17, 1901.
1260	3	,,	Torres Strait.		
1274	2	,,	Sokari, Amami-Ōshima.	Mitsukuri & Ikeda	Mar. 29, 1901.
1292	1	,,	Hirashima, Hahajima Group, Ogasawara Is.	Yoshiwara	Summer, 1901.
1291	1	,,	Ōgiura, Chichijima, Ogasawara Is.	,,	,,
Agas. 25 *e*	1		Papeete, Tahiti.	A. Agassiz	Sept. 28, 1899.
Agas. 12	1		Rengiroa I.	,,	Sept. 21, 1899.
1319	1	Dried	Liu-Kiu		

Description :—Tentacles 20. Dorsal papillae and ventral pedicels of nearly equal size, scattered all over. "Disks of the tables forming a simple ring, often with a small hole at the base of each vertical rod; spire terminating in eight horizontal and four vertical, rather long teeth. The small fenestrated plates are evenly rounded or undulated on the margin; they are often undeveloped, X-shaped with the arms slightly branched" (Théel

1886, p. 213). "Die Stützstäbe der Rückenpapillen mit durchlöcherter Ausbreitung an den Enden. Kräftiger Kalkring. Poli'sche Blasen und Steinkanäle wechseln in Zahl und Grösse nach den Fundplätzen der einzelnen Thiere; die Poli'schen Blasen in der Zahl 2—6, selten einfach, die Steinkanäle bilden jederseits vom Mesenterium einen Büschel von 8—30 Schläuchen." (Lampert 1885, p. 86). Color black or dark-brown, sometimes with 6—10 pairs of dark-brown spots on the back. Body 35 cm. long. Those individuals with the margin of the disk of the table toothed, and with the tips of papillae and pedicels black as the rest of the body, have been distinguished as *H. amboinensis* Semper or var. *amboinensis* Semper. Those with the margin of the disk smooth and with the tips of papillae and pedicels white, are supposed to belong to the species proper or are distinguished as var. *affinis* by Bedford. There are, however, said to be all stages of intermediate forms.

Remarks:—The specimens I have examined are black with a tinge of purple. Smaller specimens preserved in stretched condition brownish. Dorsal and ventral surfaces distinct. One of the specimens which I had specially marked when living as having "ends of pedicels white on account of end-plates" has in alcohol lost this characteristic entirely. I regret that I did not record a similar observation on another specimen; in alcohol they show no difference from that which I marked. Hence it is reasonable to conclude that whether the tips of pedicels are white or not, can not be determined from alcoholic specimens. Therefore, one of the supposed distinctions between *H. atra* and var. *amboinensis* can not be made out in preserved specimens.

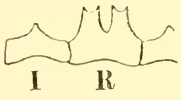
As to the tables, my preparations show that those from one and the same specimen are partly smooth on the disk

margin and partly spiny. The disk is, as described by THÉEL, mostly with a ring and an opening at the base of each pillar. In others, especially in those with a spiny margin, the disk may become large and have more holes. Fenestrated plates may be simply X-shaped or more elaborate.

Stone-canals and Polian vesicles vary greatly in number as the following table will show:—

Sci. Coll., Spec. No.	Size of body	Stone-canals		Polian vesicles
		Left	Right	
1196	Small	7	6	5 (3 large, 2 small)
1039	Middling	10	12	7 (1 very large)
1141	Very large	42	33	10 (2 or 3 large ones with numerous small vesicles in varying parts of the ring canal)
1026	Small	5	7	1

Calcareous ring as shown in textfig. 14.



Textfig. 14.

Holothuria atra: Calcareous ring. I—Interradialia; R—Radialia.

The above facts seem to point to the conclusion that there is no distinction between *H. atra* and var. *amboinensis*.

The animals are found in shallow water (2—3 fathoms).

I have no specimen cured for market, but this is one of the commercially useful species as given by SEMPER, KENT, &c.

Locality:—Querimba (SEMPER '69); Red Sea (SEMPER '69, LUDWIG '80, LAMPERT '85); Assab (LUDWIG '87); Zanzibar (SELENKA '67, LAMPERT '85, LUDWIG 87); Bawi, Tumbatu (LAMPERT '96); Aldabra (LUDWIG '99); Mozambique (BELL '84); Darros I., Amirante Is. (BELL '84); Western Indian Ocean (BELL '84); Ceylon (LUDWIG '87, BELL 87); Tuticorin, Madras (BELL '88); Andaman Is. (BELL 87); Nicobar Is. (SEMPER '67—'68); El-

phinstone I., Mergui Is. (Bell '86); Bay of Bengal (Bell '88); Indian Ocean (Ludwig '82); Padang (Ludwig '82); Djedda (Ludwig '82); Thousand Is. (Sluiter '95); Java (Selenka '67); Batavia (Sluiter '87); Sunda Is. (Koehler '95); Timor (Ludwig '82, Sluiter : 01); Lucipara I. (Lampert '89, Sluiter : 01); Saleh Bay (Sluiter : 01); Sebangkatan (Sluiter : 01); Lombok (Sluiter : 01); Lunu-Lunu (Sluiter : 01); Seba (Savu) (Sluiter : 01); Kabala dua (Sluiter : 01); Haingsisi (Sluiter : 01); Roma (Sluiter : 01); Kangeang (Sluiter : 01); Jedan I. (Sluiter : 01); Celebes (Jaeger '33, Lampert '85); Macassar (Ludwig '82); Amboina (Selenka '67, Semper '67—'68, Ludwig '82, Lampert '85, Théel '86, Sluiter '94, '95); Batjan, Moluccas (Semper '67—'68); Moluccas (Semper '67—'68); Philippine Is. (Semper '67—'68); Zebu (Lampert '85); Uolan (Brandt '35); ? Radack Is. (Chamisso '21); Mermaid Strait, Dampier I. (Lampert '89); "Challenger" Stat. 177. (Théel '86); Great Barrier Reef (Kent '93); Adelaide (Lampert '85); Funafuti (Whitelegge '96, Bedford '98); Rotuma (Bedford '98); Fiji (Semper '67—'68, Théel '86); Tonga (Théel '86); Penope (Théel '86); Samoa (Semper '67—'68); Society Is. (Selenka '67); Tahiti (Ludwig '83); Sandwich Is. (Selenka '67); Florida (Pourtalès '51, Selenka '67); ? Bermuda (Heilprin '88); Havana (Ludwig '83); Jamaica (Ludwig '83); Puerto Cabello (Ludwig '83, Lampert '85); Torres Strait; Liu-Kiu; Ogasawara Is.; Amami-Ōshima.

18. *Holothuria bivittata*, sp. n.

(Pl. III., fig. 31; textfig. 75).

Specimens examined :—

Sci. Coll., Spec. No.	Number of individuals	Preservation	Locality	Depth in *hiro*	Collector	Date
1217, 1218	2	Alc.	Chinenzaki, Okinawa Is.	3.5	Mitsukuri	Apr. 15, 1901.
1024	3	„	Liu-Kiu Is.			
1025	1	Cured	„			
1140	1	Dried	Miyakojima, Yayeyama Is., Liu-Kiu.			

Description :—Tentacles 20, small. Length of body in life ca. 30 cm. ; in alcohol quite 18 cm. Color markings very characteristic : dorsum and ventrum very differently colored. The ground color of the former, yellow to brown ; on this, two broad dark-brown transverse bands cross the whole breadth of the dorsum. One of these is at about $\frac{1}{6}$—$\frac{1}{4}$ of the body length from the anterior end, and is over 2 cm. in breadth ; the other is at about the same distance from the posterior end and is of about the same breadth. Sometimes the band may not entirely cross the whole width of the body. The ventrum is lighter than the dorsum, and varies from a uniform brown to almost a white.

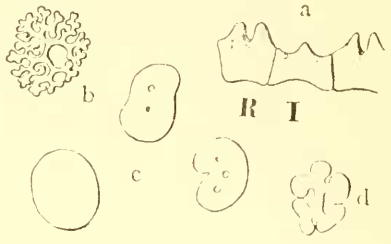
Ambulacral appendages very numerous, uniformly distributed in the ambulacra as well as the interambulacra without any regular arrangement, on both the dorsum and the ventrum. Dorsal appendages have end-plates almost as well developed as those of the ventrum. Hence all must be considered as pedicels. Except near the anterior and posterior ends I can not detect a single papilla. In life, however, the dorsal pedicels may appear like papillae ; for in my notes on the living animal, I put down " Dorsal surface papillae only. Small end-plates ?" There are no large supporting rods, but there are delicate X-shaped spicules, which are somewhat larger than the calcareous bodies in the body wall. Some of these have long branches at both ends ; others are more rod-like with the ends slightly bifurcated. There are all intermediate stages between these.

Calcareous deposits are very much as in *H. marmorata*. In the dorsal perisome, they consist almost entirely of delicate rosettes of 20—25μ (textfig. 15 *b*). They start with the X-shape, but the branches at the ends divide dichotomously 2—4 times and the whole looks like a delicate filigree-work. In the

ventral perisome, the calcareous deposit is greater in quantity. The spicules are made on essentially the same plan as those in the dorsum, i.e., they are rosettes but of a much plumper appearance (*d*). The most delicate among them come near to the dorsal rosettes, but are plumper even then. The more plump among them are decidedly broader. They may even become oval or biscuit-shaped grains with or without holes (*c*). They measure 22—36μ.

Anus in life a large circular opening with five groups of small papillae projecting into it. It no doubt becomes stellate, according to the condition of preservation.

Polian vesicle one, long, may be over 5 cm., situated in the left ventral interradius. Stone-canal attached to the mesentery, running forward in a sinuous course from the circumoral vessel, terminating near the calcareous ring with a slightly enlarged end. Calcareous ring as figured in *a*. Cuvier's tubes developed mostly on the left respiratory tree, but some on the right also. The tubes together form a very large mass.



Textfig. 15.

Holothuria bivillata: *a*—Calcareous ring; *b*—Delicate rosette of dorsum; *c*—Oval grains of ventrum; *d*—Plump rosette of ventrum. (*b*—*d* × 400). I—Interradialia; R—Radialia.

Remarks:—Liu-Kiuan name —" Suna-haya."

Among the species I have examined, *H. argus*, *H. marmorata* and the present species resemble one another very closely. I therefore think that THÉEL's belief that *H. marmorata*, *H. argus*, *H. vitiensis*, *H. tenuissima*, *H. köllikeri*, *H. clemens*, *H. similis* are probably only young individuals or varieties of one and the same species, has much to recommend it. A somewhat exhaustive

examination of the three species first mentioned convinces me that they resemble one another very closely in almost every anatomical detail:—in the calcareous deposits, the structure of the Cuvierian tubes, in the arrangement of the Polian vesicles and of the stone-canal, in the nature of ambulacral appendages, etc. But the reason why I have kept *H. marmorata* and *H. argus* separate and have ventured to burden the already overstocked nomenclature by establishing the present species is, that each of the three species has very characteristic and well-established color-markings of its own. It is true that one can not place much reliance on mere external markings, but in these cases they are so constantly and strikingly different, and so entirely without intermediate gradations, that the three species are distinguished with ease by the Liu-Kiu natives and have different names assigned by them. Such differences should also be taken notice of in science, and distinctive names be given the species for future reference. Whether the differences are specific or varietal can perhaps only be determined by a long study on the spot, and even then it may after all turn out to be a mere matter of fancy whether they should be assigned specific or varietal values. For the present, I have thought it best to give them specific values.

19. *Holothuria cinerascens* (Brandt).

(Textfig. 16).

Stichopus (*Gymnochirota*) *cinerascens* Brandt 1835, p. 51.—Ludwig 1881, p. 597.

? *Holothuria umbrina* Rüppel & Leuckart 1828, p. 10, Taf. II., Fig. 4.

Stichopus cinerascens (?) Grube 1840, p. 36.—Selenka 1867, p. 319. —Semper 1867—'68, pp. 74, 275.

Holothuria pulchella Selenka 1867, p. 329, Taf. XVIII., Fig. 61—62. —Semper 1867—'68, pp. 89—90, 278.—Semper 1869, p. 120.—Haacke 1880, p. 46.—v. Marenzeller 1881, p. 139.—Ludwig 1883, p. 171.—Théel 1886*a*, p. 212.—Sluiter 1887, p. 187.—Sluiter 1895, p. 77.

Holothuria cinerascens Lampert 1885, p. 82.—Ludwig 1887*a*, p. 3.—Bell 1887*a*, pp. 654—657, Pl. XL., fig. 2.—Ludwig 1889—'92, p. 329.—Lampert 1896, pp. 55—56.—Mitsukuri 1896, p. 407.— Bedford 1899*a*, p. 54.—Ludwig 1899, p. 561.—Sluiter 1901*b*, p. 9.

Specimens examined :—

Sci. Coll., Spec. No.	Number of individuals	Preservation	Locality	Collector	Date
1029	3	Alc.	Kagihama & Ōmura, Chichijima, Ogasawara Is.	Hirota & Sekiguchi.	
1028	3	,,	Susaki, Chichijima.	,,	
1178	1	,,	Okinawa I., Liu-Kiu.		
1045	1	,,	Makurazaki, Satsuma.	Miyajima	
1219	5	,,	Nōi Reef Nakagusuku Bay, Okinawa, among holes in the coral rocks.	Mitsukuri, Ikeda & kuroiwa.	Apr. 16, 1901.
1287	1	,,	Hirajima, Hahajima, Ogasawara Is.	Yoshiwara.	Summer, 1901.

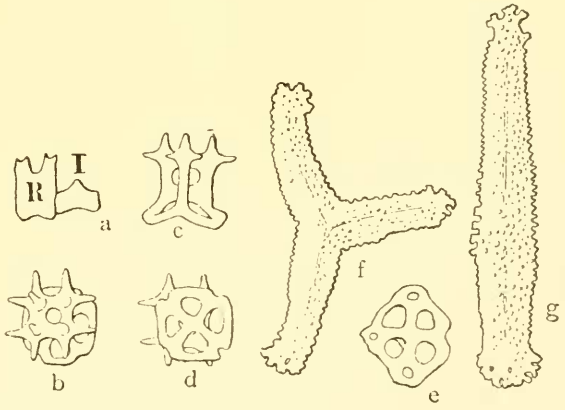
Description :—Tentacles 20. The ventral pedicels are much more crowded than the papillae of the dorsum and the sides, from which they are quite distinct. Calcareous deposits :—the spire of the tables is supported by a reduced, almost annular disk and carries twelve teeth on the top. Below the tables lie numerous slightly curved rods 0.1 mm. long and 0.01 mm. broad, which are distinguished by a finely granulated surface. In the walls of the pedicels, no other calcareous structures occur. Polian vesicles 2—3 (1—7, Semper). Long stone-canals 8—10 (1, 3, 8—10, Semper), in a bundle on the left of the mesentery. Cuvierian organs present according to several authors (v. Martens, Lampert, Sluiter). Color greyish brown, often with two rows of large

bluish black spots. Ventrum sometimes lighter.

Remarks:—This species is confined to the southern half of Japan. I have specimens not only from the Ogasawara Is. as reported by Brandt, but also from the Okinawa Is. In Japan proper there is a specimen from Satsuma. It is somewhat remarkable that no specimen of this species has yet been found in Misaki, seeing that v. Marenzeller reports it as from Enoshima close by.

One Ogasawara specimen, not much contracted, agrees well with the description given by authors in color and markings, i.e., in being reddish brown with two rows of large, irregular, black spots, 7—8 in one row. The contracted specimens often acquire a peculiar appearance which serves for preliminary specific determination. The dorsum (in alcohol) acquires a purplish brown tinge with papillae standing out as spots of a reddish brown. Moreover, the surface is marked out into irregular polygonal areas.

Tables (textfig. 16 *b* — *e*) are rather sparse. The disk usually consists of only an annulus or at the most, has only a small additional opening and appears like a rather square disk (*e*). The spire arises directly from the annulus and ends above in a crown with four groups of



Textfig. 16.

Holothuria cinerascens: *a*—Calcareous ring; *b*—*e*—Tables; *f*, *g*—Rods. (*b*—*g* × 300). I—Interradialia; R—Radialia.

three teeth each. Rods (*f,g*) are very numerous, slightly curved, finely granular all over, and more or less irregular at the two extremities.

When the stretched skin of the dorsum is viewed from the inside, many black spots are visible; they are smaller and far more numerous than the black spots visible from the outside.

Pedicels very numerous on the ventrum. Papillae of the dorsum (some with no end-plates, others with well-developed end-plates) more sparse. No other kind of supporting rods than the finely granulated curved rods. No Cuvierian organs found, at least in those examined. Calcareous ring as in textfig. 16*a*. There are 5—12 appendages to the ring canal; it was very difficult to determine how many of these were Polian vesicles and how many stone-canals, for they have almost the same shape. In one specimen, there was a tube branched into one short and two long fingerlike blind tubes, which seemed to be a branching Polian vesicle.

The largest individual in well extended state measured 15 cm. in length.

Locality:—Kosseir (Lampert '85); Zanzibar (Lampert '86); Tumbatu (Lampert '96); Mozambique (Semper '67—'68); Mauritius (Haacke '69, Ludwig '83); Seychelles (Lampert '85, Ludwig '99); Ceylon (Bell '87); Java (Semper '67—'68); Batavia Bay (Sluiter '87); Sunda Is. (Semper '67—'68); Sunda Strait (Sluiter '95); Seba (Savu) (Sluiter : 01); Roma (Sluiter : 01); Bai von Pidjot, Lombok (Sluiter : 01); Camiguin (Semper '67—'68); Ogasawara Is. (Brandt '35); Enoshima (v. Marenzeller '81); New Caledonia (Bedford '99); Sandwich Is. (Selenka '67); Honolulu (Ludwig '87); Tahiti (Théel '86); Marquesas (Théel '86); Ogasawara Is.; Liu-Kiu; Satsuma.

20. *Holothuria difficilis* Semper.

Holothuria difficilis Semper 1867—'68, pp. 92, 279, Taf. XXX., Fig. 21. —Ludwig 1883, pp. 156, 173.—Lampert 1885, p. 68.—Théel 1886*a*. p. 219.—Ludwig 1888, pp. 807—8.—Ludwig 1889—'92, p. 329.—Sluiter 1889, p. 107.—Bedford 1898, p. 838, Pl. LII., fig. 3.—Sluiter 1901*b*, p. 10.

Mülleria pervula Haacke 1880, p. 46.

Specimens examined :—

Sci. Coll., Spec. No.	Number of individuals	Preservation	Locality	Collector	Date
1044	Numerous,	Alc.	Hattan Is., Formosa.	Tada	Mar. 1897.
1286	1	,,	Hirajima, Hahajima, Ogasawara Is.	Yoshiwara	Summer, 1901.
1293	1	,,	,,	,,	,,
1299	Several	,,	Amami-Ōshima, Ōsumi(?)	Mitsukuri & Ikeda	Mar.—Apr., 1901.

Description :—"Die Papillen des Rückens stehen sehr weit auseinander. 20 Tentakel, Einfarbig braun. Länge etwa 7 Cm. in Spiritus. Der Kalkring ist ziemlich gross. Ein kleiner dorsaler Steincanal, eine Polische Blase. Basis der Geschlechtstheile sehr dicht hinter dem Gefässring; die Follikel sind dünn, etwa 3 Cm. lang, 2 bis 3 mal getheilt. An den Lungenästen sitzen bis noch hinauf sehr zahlreiche, nur 1½ Cm. lange und dünne Cuvier'sche Schläuche." (Semper p. 92). "The dorsal papillae very thinly scattered. Ventral surface with pedicels. The disks of the tables well developed, with numerous peripheral holes, and the spire terminating in four groups of teeth, each group composed of several (five to seven) teeth. Buttons large, of normal shape, slightly asymmetrical." (Théel).

Remarks :—All the specimens are small, the largest being about 5.5 × 1.5 cm. in alcohol. They are all uniformly brown-colored. Dorsal papillae are somewhat thinly scattered, but in some specimens they seem to stand in a double row on each of the dorsal ambulacra. They are placed on conical warts. Ventral pedicels are much more crowded, but in many specimens, they can be made out to be arranged in three longitudinal zones. Reproductive organs on the left side only ; so far as dissected, they consisted of simple unbranched tubes. This was no doubt due to the immature condition of the specimens. Polian vesicles two on the ventral side. Stone-canal single, attached to the dorsal mesentery, small but comparatively thick. Cuvierian organ present, attached to the lower part of the respiratory tree, and coiled into an oval mass in alcohol. Calcareous ring small.

Tables among calcareous deposits are large with large peripheral holes. Buttons plump, smooth-edged. Some with three pairs of holes ; those with four, five or more holes are comparatively numerous in at least one of the rows. The two sides very often differ in the number of holes.

I believe that *H. difficilis* and *H. captiva* ought to be made into a single species. In fact my specimens agree in some respects better with the descriptions of *H. captiva*. For instance, the attached stone-canal as stated by Ludwig and the rows of tube-feet as stated by Bedford, are all found in my specimens, while I can not ascertain how they are arranged in *H. difficilis*. The reason why I have assigned the name of *H. difficilis* to my specimens is : 1) because this name has priority, 2) because *H. captiva* has been reported hitherto from the Atlantic only, while *H. difficilis* is reported only from the Indo-Pacific. With a little more reserve, I think that *H. farcimen* Selenka ought to be

united to this species, but the published account of that form is very meagre. I also think that all the forms mentioned are closely related to *H. monacaria* Lesson. In fact, there is very little to distinguish them from the latter species: the only points seem to be that the stone-canal is attached in *H. difficilis* (or at least in *H. captiva*), while it is not in *H. monacaria*, and that in the Atlantic where *H. captiva* is found, *H. monacaria* has not been found.

Locality:—Mauritius (Haacke '80, Ludwig '83); Amboina (Ludwig '88); Pulo Edam (Ludwig '88); Bay of Batavia (Sluiter '89); N. point of Tiur I. (Sluiter : 01); Rotuma (Bedford '98); Samoa (Semper '67—'68); Formosa; Ogasawara Is.; Ōsumi (?)

I append here the references to *H. captiva* and *H. farcimen* with their distribution.

Holothuria captiva Ludwig 1874, p. 32, Fig. 45.—Ludwig 1883, p. 173.—Lampert 1885, p. 68.—Théel 1886*a*, p. 220.—Heilprin 1888, p. 311, Pl. XIV., fig. 4, 4*a*.—Ludwig 1889—'92, p. 329.—Sluiter 1895, p. 79.—Clark 1898 p. 413.—Clark 1899, pp. 125, 133.—Clark 1901*b*, p. 257.

Locality:—Barbados (Ludwig '74, Sluiter '95); Sine patria (Ludwig '74, Lampert '85); Bartholomew (Théel '86); Bermuda (Heilprin '88, Clark '98); Porto Rico (Clark : 01).

Holothuria farcimen Selenka 1867, p. 330, Taf. XVIII., Fig. 65.—Semper 1867—'68, pp. 92, 279.—Lampert 1885, p. 68.—Théel 1886*a*, p. 220.—Ludwig 1889—'92, p. 329.—Perrier : 00, p. 299.

Locality:—Azores (Selenka '67).

21. *Holothuria edulis* Lesson.

Holothuria edulis Lesson 1830, pp. 125-6, Taf. XLVI., Fig. 2.—Selenka 1867, p. 341.—Semper 1867—'68, pp. 89, 278, Taf. XXXI., Fig. 7, Taf. XXXII., Fig. 4, Taf. XXXIII., Fig. 3, Taf. XXXVI., Fig. 2, 5, 9, 10.—Semper 1869, p. 120.—Ludwig 1882, p. 137.—Lampert 1885, p. 81.—Théel

1886*a*, p. 216.—Ludwig 1887*b*, p. 1227.—Ludwig 1888, p. 807.—Ludwig 1889—'92, p. 329.—Kent 1893, p. 237.—Sluiter 1894, p. 103.—Koehler 1895*d*, p. 281.—Sluiter 1895, p. 79.—Bedford 1899*a*, p. 147.—Ludwig 1899, p. 559.—Sluiter 1901*b*, p. 8.

Trepang edulis Jaeger 1833, p. 24.—Brandt 1835, p. 57.

Holothuria fuscocinerea Selenka 1867, p. 337, Taf. XIX., Fig. 86.

Holothuria signata Ludwig 1874, p. 23, Fig. 36.—Lampert 1885, p. 64. —Théel 1886*a*, p. 222.—Ludwig 1889—'92, p. 330.—Lampert 1896, p. 53.

Specimens examined :—

Sci. Coll., Spec. No.	Number of individuals	Preservation	Locality	Depth in *hiro*	Collector	Date
1038	4	Alc.	Futami Harbor, Chichijima, Ogasawara Is.		Hirota and Sekiguchi	Apr. 9, 1895.
1060	3	Dried				
1209	4	Alc.	Satsukawa, Amami-Ōshima, Ōsumi.	2.5	Mitsukuri and Ikeda	Mar. 30, 1901.
1210	3	„	Sokari, Amami-Ōshima.		„	Mar. 29, 1901.
1285	2	„	Ōgiura, Chichijima, Ogasawara Is.		Yoshiwara	Summer, 1901.
	2	„	Manjuyod, South Negros, Philippines.		B. Dean	Feb., 1901.

Description :—Tentacles 20. Dorsal papillæ minute and more scattered than the ventral pedicels. 2–5 Polian vesicles; 2–5 stone-canals united into a bundle. The disks of the tables reduced to a small ring narrower than the top of the spire, which, seen from above, presents a small circular hole surrounded by four prominences, each with about four or five minute teeth. The fenestrated plates nearly like those in *H. grisea*. Dorsum violet-black. Ventrum and the sides beautiful red. Length of body 10 cm. In alcohol, dark reddish-brown on the back, light greyish on the ventral surface and the sides. A minute dark ring round the base of light-colored pedicels. (After Lampert and Théel).

Remarks :—Coloring very characteristic in fresh state. It is violet-black on the dorsum and bright red on the ventrum. Pedicels and papillæ in a somewhat contracted state appear black. In alcohol, the dorsum is violet-black, while the sides and ventrum are light grey with a tinge of red in some parts.

In fresh condition, the three specimens from Sokari measured respectively :

Length in cm.	27	25	23
Circumference in cm.	12	8	8

In alcohol the above specimens have contracted to 13, 12, and 8.5 cm. in length respectively. A large preserved specimen from Satsukawa measures 16 cm.

Dorsal papillæ are black, minute, less numerous than the ventral pedicels. The latter appear as dark dots on the light grey surface. On most specimens these are most numerous on each side of the ventral median line, which, together with a lateral line on each side, has hardly a single pedicel.

Polian vesicles 2—3, to the left of the dorsal mesentery. Stone-canals minute and in a bundle of 6—7 on each side of the dorsal mesentery.

Calcareous deposits are of two kinds—tables and buttons. Tables are of a peculiar shape. There is hardly any disk developed. The spire, which is tolerably high and has one cross-piece, ends in a crown which is larger than the other end. Each of the four corners of the square crown has generally three or more teeth, pointing as the three dimensions of space. Often five pillars are present in the spire. Buttons are small. There are some which approach regular buttons, but most of them are simple lozenge-shaped pieces with four openings, of which two are large and two are small. There are many imperfect buttons.

The species is called "Akami-Shikiri" (red flesh holothurian) in Amami-Ōshima. Although I have no specimens from Okinawa, I am told by NABISA, an intelligent Liu-kiuan, that although rare it occurs there, and is known as "Aka-wata" (red belly).

The animal is found at 2—3 fathoms' depth.

Locality:—Aden (SEMPER '69); Mozambique (SEMPER '67); Tumbatu (LAMPERT '96); Zanzibar (LUDWIG '99); Ceylon (LUDWIG '87); Java (LUDWIG '82, SLUITER '94); Lumu-Lumu (SLUITER: 01); Saleyer I. (SLUITER: 01); Ceram (SLUITER: 01); Haingsisi (SLUITER: 01); Timor (LUDWIG '82); Celebes (LUDWIG '82); Moluccas (LESSON '30, SLUITER '95); Bohol, Philippines (SEMPER '67); Amboina (SELENKA '67, LUDWIG '82, LUDWIG '88, SLUITER '94); Caroline Is. (LESSON '30); Marshall Is. (LAMPERT '85); Great Barrier Rief (KENT '93); New Holland (LESSON '30); New Britain (THÉEL '86); Lifu (BEDFORD '99); Fiji (THÉEL '86); Tahiti (LUDWIG '74); Manjuyod; Ogasawara Is.; Ōsumi.

22. *Holothuria impatiens* (FORSKÅL).

(Textfig. 17).

Fistularia impatiens FORSKÅL 1775, pp. 121–2, Taf. XXXIX., Fig. B.—LAMARCK 1816, p. 76.—LAMARCK 1840, p. 448.

Holothuria impatiens LINNÉ 1788, p. 3142, Nr. 21.—SELENKA 1867, p. 340.—SEMPER 1867–'68, p. 277.—SEMPER 1869, p. 120.—GRAY 1872, p. 123.—LUDWIG 1879, p. 569.—v. MARENZELLER 1874, p. 320.—LUDWIG 1879, p. 569.—HAACKE 1880, p. 46.—LUDWIG 1880, p. 6.—LUDWIG 1882, p. 136.—LUDWIG 1883, p. 169.—BELL 1884, p. 510.—LAMPERT 1885, p. 65.—THÉEL 1886*a*, pp. 179, 233–4, Pl. VIII., fig. 9.—BELL 1886, p. 28.—THÉEL 1886*b*, p. 7.—LUDWIG 1887*a*, p. 31.—LUDWIG 1887*b*, p. 1226.—BELL 1887*a*, p. 140.—BELL 1887*b*, p. 654.—SLUITER 1887, p. 193.—LUDWIG 1888, p. 806.—BELL 1888, p. 389.—(?) HEROUARD 1888.—HEROUARD 1889, p. 677.—LUDWIG 1889–'92, p. 329, Taf. XVII., Fig. 2.—HEROUARD 1893, p. 134.—KENT 1893, p. 237,—SLUITER 1893, p. 103.—(?) KOEHLER 1894, p. 422.—KOEHLER 1895*b*,

p. 12, Fig. 11.—Koehler 1895*d*, p. 282.—Sluiter 1895, p. 78.—Lampert 1896, p. 54.—Bordas 1898, pp. 568–570.—Östergren 1898*b*, pp. 233–237.—Bedford 1899*a*, pp 840–1.—Ludwig 1899, p. 558.—Bedford 1899*b*, p. 145.—Bordas 1899*a*, p. 16 Pl. I.—Bordas 1899*b*, pp. 187–204, p. 4.—Russo 1899, pp. 133–141, Pl. III*a*.—Russo 1900, pp. 38–41.—Sluiter 1901*b*, p. 9.—Clark 1901*b*, p. 258.—Clark 1902*b*, p. 528.

Holothuria fulva Quoy & Gaimard 1833, p. 135.

Trepang impatiens Jaeger 1833, p. 25.

Thyone impatiens Blainville 1834, pp. 193–4.

Holothuria (*Camarosoma*) *impatiens* Brandt 1835, p. 53.

Sporadipus impatiens Grube 1840, pp. 35, 36–7.

Holothuria botellus Selenka 1867, pp. 335–6, Taf. XIX., Figs. 82–84.—Semper 1867–68, pp. 82, 248–9, Taf. XXII., Taf. XXXIII., Fig. 2, Taf. XXXV., Figs. 15, 16, Taf. XXXVII., Fig. 13, Taf. XXXVIII., Figs. 3, 4, 7.—Selenka 1868, p. 117.—Kent 1893, p. 238.

Holothuria impatiens (*botellus*) var. Ludwig 1874, p. 36, Fig. 51.

Holothuria botella Graeffe 1881, p. 344.

Specimens examined :—

Sci. Coll., Spec. No.	Number of Individuals	Preservation	Locality	Collector	Date
1228	1	Alc.	Sakibaru, Naha, Okinawa, among dead coral reefs.	Mitsukuri and Ikeda	Apr. 7, 1901.
1232	4	,,	Inan-ze, Naha, Okinawa, among dead coral reefs.	,,	Apr. 18, 1901.
Agas. 4	2	,,	Makemo I., Paumotu.	A. Agassiz	Oct. 20, 1899.
1275	1	,,	Manjuyod, South Negros, Philippine Is.	B. Dean	Feb. 1910.
Agas. 7*a*	1		Fakarava, Paumotu.	A. Agassiz	Oct. 12, 1899.

Description :—Tentacles 20. "Körper schlank. Die Warzenfüsschen über den ganzen Körper gleichmässig zerstreut, vor der Mundöffnung in einem Kreis gestellt. Die thurmförmigen Kalkkörper der Pigmentschicht sehr gross, 0,068 Mm. hoch, auf 0,1

Mm. grosser Basis stehend, in der Form von denen aller übrigen Holothurien durch die mehrfache Verbindung der vier Hauptstäbchen durch Querleisten ausgezeichnet. Die zahlreichen schnallenförmigen Gebilde der Bindegewebsschichte flach, 0,075–0,1 Mm. lang. Alle Füsschen besitzen in ihren Wandungen Stützstäbchen von 0,2 Mm. Länge.—Farbe der Thiere dunkelbraunroth, graubraun; bisweilen grau und braun gefleckt. ..... bis zu 25 Cm. Länge,..... Die Tentakeln sind klein, hellbraun. Kalkring ziemlich klein, ganz ähnlich dem von *Hol. grisea.* Lunge nicht sehr reich verästelt; Cuvier'sche Organe blinddarmförmig. Poli'sche Blase einfach; Steincanal frei, klein, mit lanzettförmigen Madreporenköpfchen. Geschlechtsöffnung auf dem Rücken, einige Millimeter hinter dem Papillenkranze, welcher die Mundöffnung umstellt." (Selenka 1867, p. 335). "Die Färbung des lebenden Thieres ist sehr variabel, meist gelbbraun mit grossen unregelmässigen Flecken, mitunter ganz einfarbig gelb, oder auch fast schwarz. ..... Die Cuvier'schen Schläuche sind 4–5 Cm. lang bei 2 Mm. Dicke. Poli'sche Blasen 2, bei einigen sogar 5. ..... Der immer einfache Steincanal variirt sehr in Grösse. ..... Auch die Stühlchen der Haut sind ziemlich variabel. In Selenka's Originalexemplar hat die Mehrzahl derselben allerdings die 2 Queräste des Stieles, die er als so besonders charakteristisch für diese Art ausgiebt, doch finde ich auch einzelne mit nur einem Querast darunter; bei andern Exemplaren ist dagegen die letztere Form überwiegend gegen die typische mit 2 Querästen." (Semper 1867–8, p. 82). "Unter einer ganzen Zahl von Holothurien von Tahiti.....fand ich ein Exemplar.....welches in allen Stücken mit den typischen Exemplaren dieser Art übereinstimmt, jedoch in der Färbung des Körpers eine interessante Varietät darbietet. Die Haut ist nämlich hell

gelbbraun und trägt auf dem Rücken zwei Längsreihen dunkelbrauner Flecken, wodurch dieses Individuum auf den ersten Anschein zu *Hol. pardalis* Sel. zu gehören scheint." (Ludwig 1874). "Scheibe der sehr grossen Stühlchen fast stets mit 8 peripherischen Löchern. Stiel in zahlreiche Zacken auslaufend; sehr oft mit 2, manchmal mit 1 Querleiste; da aber der Stiel sehr plump, so ist, wenn auch eine Doppelverbindung vorhanden ist, diese doch schwer zu sehen. ..... Haut rauh." (Lampert 1885). "The symmetrical buttons have always six holes..... Papillæ numerous, equally distributed all over the body, and situated on rounded warts." (Théel 1886*a*). "Body in extension elongate subcylindrical, tapering anteriorly; thickly beset with wart-like elevations that represent the bases of the tactile acetabula; colour of the general surface of the body grey, that of the wart-like papillæ light yellow; oral tentacles, ventral pedicels and tactile acetabula light yellow." (Kent).

Remarks:—All the specimens I have examined are rather small. The Sakibaru specimen is 5.7 by 2.3 cm. in its present contracted state. The Inanze specimens are respectively 3.5, 4, 3.5, 3.7 cm. long in the contracted state. The Paumotu specimens are respectively 3.7 and 2.4 cm. long. But when living, they must have been twice or more than twice as long, as all the specimens are wrinkled transversely over the whole body. They are all rough and tough to the touch.

The Sakibaru specimen is greyish brown with dark-brown, almost purplish, patches scattered over the dorsal surface, especially near the anterior end; dark brown spots are also scattered mostly on the dorsum but some also on the ventrum. The tips of the ambulacral appendages are straw-yellow. The Inanze specimens are also dark-brown, or almost purplish, and

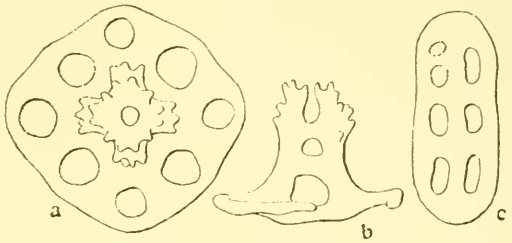
grey-brown mixed and mottled in various ways. The Paumotu specimens show likewise a mixture of purplish brown and grey-brown areas and patches. The tips of the pedicels have remained straw-yellow, which is no doubt the color in the living animal. In all the specimens the ventrum is somewhat lighter.

In the accepted descriptions, the ambulacral appendages are put down as papillæ all over the body, but in the specimens examined, the ventral appendages have well-developed end-plates and must therefore be called pedicels. Hence they must be described as having dorsal papillæ and ventral pedicels. In this respect, the specimens are like *H. bowensis*, but they agree in all other details so strongly with *H. impatiens* that they must be put in the latter species. In fact I am led to suspect that *H. bowensis* is a variety of *H. impatiens*, the only point of difference being that in the former some of the buttons have knobs on the middle beam. Östergren (p. 235) says: "Wenn man kleine Exemplare dieser Art (*H. impatiens*) untersucht, findet man die Füsschen ganz wie bei *H. aphanes* geordnet. Auf der Rückenseite sind alle papillenförmig, während man auf dem Bauche in den 3 Radien Doppelreihen von Füsschen mit typischer Form findet. Während des Wachsthums entstehen dann sowohl auf den Interradien des Bauches, als auf dem Rücken zahlreiche von Warzen getragene Papillen. Auch unter den radialen Füsschen auf der Bauchseite wird die Haut warzig verdickt, weshalb diese Füsschen irrig als Papillen aufgefasst worden sind, obgleich sie auch bei Erwachsenen grosse Saugscheiben haben."

In the Sakibaru specimen, which is the least contracted of all the specimens in my possession, the appendages can be recognized as forming rows on the ambulacra. They are all borne on rounded eminences or warts of more or less prominence. Those

on the anterior part of the dorsum have the most conspicuous warts.

The calcareous bodies are tables and buttons. Tables (textfig. 17 *a*, *b*) are large and very thickly spread on the surface of the body. On examining with a hand-lens, the spires of the tables may be recognized as minute, thickly-set spines sticking out from the surface of the body. The basal disk has a smooth margin and is almost always 0.1 mm. in diameter and somewhat rectangular with rounded corners. It has eight large holes in the periphery and one larger central hole. Over the central hole rises the spire with four columns. It is about 0.08 mm. in height, and tapers gradually upward. It has mostly two crossbeams besides the coronal connection. Over ten teeth project not only from the crown but also from the columns at the level of the crossbeams. Tables with one crossbeam are also frequently met with in some specimens. Buttons (*c*) are regular, almost always with three pairs of holes. The margin is smooth and somewhat crenate. Supporting rods in the ambulacral appendages have expansions in the middle and at the two ends.



Textfig. 17.

Holothuria impatiens: *a*, *b*—Tables; *c*—Button. (*ca.* × 270.)

In the Sakibaru specimen which was opened, two long Polian vesicles were found, one 3.8 cm. and the other 1.7 cm. long. Stone-canal one, on the right side of the dorsal mesentery, free, with an enlarged and elongated head. Sexual organs still small and immature. Cuvierian organ a bundle of about 20,

thick, unbranched, nematode-like structures (longest about 6 cm. long) with spiral markings on them, starting from the common part of the respiratory tree.

Locality :—Mediterranean (GRUBE '40, LUDWIG '79, v. MARENZELLER 74); Dalmatia (SEMPER '67–'68, LUDWIG '79); Trieste (GRAEFFE '81); Banyuls-sur-mer (HEROUARD '88, '89); La Ciotat (KOEHLER '94); Naples (LUDWIG '79); Polma (SEMPER '67–'68); Nice (SEMPER '67–'68); Red Sea (FORSKÅL 1775, SEMPER '67–'68); Insel Perim (LUDWIG '87); Suez (JAEGER '33, SEMPER '67–'68, GRAY '72, HEROUARD '93); Kosseir (LAMPERT '85); Zanzibar (SELENKA '67, LUDWIG '99); Bueni (LAMPERT '96); Tumbatu (LAMPERT '96); Mozambique (SEMPER '69, BELL '84); Juan de Nova (LUDWIG '99); Madagascar (LUDWIG '83); Gudang, Seychelles (LAMPERT '85); Mahé, Seychelles (LUDWIG '99); Mauritius (HAACKE '80, LUDWIG '83, THÉEL '86); Ceylon (LUDWIG '87, BELL '87); Andaman Is. (BELL '87); Bay of Bengal (BELL '88); Nicobar (SEMPER '67–'68); Elphinstone I., Mergui (BELL '86); Wilhelmina Bay near Padang (SLUITER '95); Java (SEMPER '67–'68); Batavia, Tausend Inseln, Billiton (SLUITER '87); Pulo Edam (LUDWIG '88); Noord Wachter Eiland (LUDWIG '88); Insel Taam; Roma; Saleyer; Kabala dua; Lumu-Lumu; Sanguisiapo; Lucipara Is.; Pulu-Passi-Tanette, Insel Damar, Seba (Savu); Bai von Bima; Insel Karakelang; Bai von Pidjot; Insel Kabaëna, Obi major, Muaras-Riff; Insel Siau; W. Küste Binongka; Pulu Barang; Labuan Badjo, Waru-Bai (SLUITER : 01); Amboina (SEMPER '67–'68, LUDWIG '82, '88, SLUITER '94, KOEHLER, '95, SLUITER : 01); Timor (LUDWIG '82, LAMPERT '85, SLUITER : 01); Banda (LUDWIG '82); Cebu (LAMPERT '85); Philippine (SEMPER '67–'68); Pelew Is. (SEMPER '67–'68); Cape York (LUDWIG '83); New Holland (QUOY and GAIMARD '33); Great Barrier Reef (KENT '93); Lifu, Loyalty I. (BEDFORD '99); Fiji (SEMPER '67–'68, LAMPERT '85, THÉEL '86); Rotuma (BEDFORD '99); Mac Kean's I. (SEMPER '67–'68); Samoa (SEMPER '67–'68, THÉEL '86); Apia and Eooa (THÉEL '86); Tonga Is. (THÉEL '86); Society Id. (SELENKA '67); Tahiti (LUDWIG '74); Sandwich Is. (SELENKA '67, THÉEL '86); Marquesas Is. (THÉEL '86); Charles I. and James I, Galapagos

(Théel '86); Galapagos (Théel '86, Clark : 02); Panama (Selenka '67); Surinam (Ludwig '74); Tortugas, Florida (Selenka '67); St. Bartholomew (Théel '86); Paumotu; Liu-Kiu Is.

23. *Holothuria isuga*, sp. n.

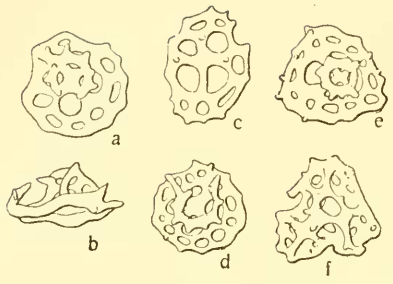
(Textfig. 18).

Specimens examined:—Three individuals from Chinenzaki, Okinawa I. (Sci. Coll., Spec. No. 1188, *a*, *b*, *c*.) taken for me at three fathoms' depth by divers under the direction of Nabisa, an enthusiastic native collector, during my trip to Okinawa in the spring of 1901.

Description.—Specimens very deep purple to almost black except the rather narrow brownish streak in the dorsal median line. Similar color around the anus and, in two specimens at least, in some parts of the ventrum (probably due to discoloration in alcohol). Pedicels all over the body, on the dorsum as well as on the ventrum, and on ambulacra as well as on interambulacra, except in the dorsal median brown streak, which is very conspicuous even in life and has long papillæ of the same color. Five groups of several papillæ around the anus. Pedicels white-tipped in fresh state. Polian vesicle single, long. Stone-canal single, free, dorsal.

In fresh condition one foot or more in length. In alcohol, highly contracted: three specimens measure 11×7, 10×7.5, and 9×6.5 cm. respectively.

Calcareous deposits are tables and buttons (textfig. 18 *a*—*f*). In one specimen, many of the tables consist simply of disks, irregular in shape, with uneven and spinous margin; the spire represented by short simple knobs. The two other specimens show a more or less partly formed spire to the tables, and



Textfig. 18.
Holothuria isuga:
a–*c*—Tables of dorsum;
d—*f*—Same of ventrum.
(×300).

besides these, some very peculiar modifications of the table. The edges of the crown, which may or may not be complete, send outward processes which unite with similar processes arising from the outer parts of the disk. The result is sometimes a very irregular and complicated figure. Buttons are mostly irregular in shape.

Remarks:—I must confess that I have been sorely puzzled over these specimens. It seems probable, judging from what has been brought out in *Stichopus japonicus*, that the tables found in these specimens are senile forms. We must then judge by those of the specimens that show the tables in a nearly perfect state. It is evident that my specimens are closely related to *Holothuria ragabunda*. But there is this difference: in *H. ragabunda* the more imperfect the tables are, the larger becomes the crown of the spire in comparison with the disk, while in the specimens under treatment the crowns are much smaller than the disk. It seemed to me that my specimens come also very close to *H. fusco-rubra*, but in that species the pedicels should be "much more numerous than the dorsal papillæ, which are comparatively few, so that an obvious line of demarcation is discernible between the dorsal and the ventral surfaces" (Théel '86, p. 182), whereas in my specimens the pedicels extend all over the body except on the narrow median dorsal streak which has long papillæ, and there is no obvious demarcation between the dorsal and the ventral surface. Moreover, for *H. fusco-rubra* no mention was made by Théel of the peculiarly modified tables, although this may be due to the fact

that he had only a single specimen which may have happened to be like the one of my specimens before alluded to. Again my specimens showed more or less likeness to *H. curiosa* and *H. lagœna*, without however fitting in exactly with either of these. It has therefore been thought best to put them separately by themselves as a distinct species, although it is with great reluctance that I introduce a new name. At the same time, it would not surprise me at all to be told hereafter that these specimens are old individuals of an already known species, e.g., of *H. vagabunda*. At present, however, there are no data for making such an assertion.

The specific name *isuga* is the name given by the natives of Okinawa to this species, as I am told by NABISA.

24. *Holothuria lubrica* SELENKA, var. *mœbii* (LUDWIG).

(Textfig. 19).

Holothuria mœbii LUDWIG 1883, pp. 171–2.—LAMPERT 1885, p. 90.—THÉEL 1886*a*, p. 206.—LUDWIG 1889–'92, p. 330.

Specimens examined :—

Sci. Coll., Spec. No.	Number of individuals	Preservation	Locality	Collector	Date
1244	Many	Alc.	Kominato, Bōshū.	Ishikawa, Okada &c.	Apr., 1885.
1245	4	,,	Morokata, Chichijima, Ogasawara Is.	Hiota and Sekiguchi	Feb.-Apr. 1894.
1246	6	,,	Ōshima, Izu.		
1248	2	,,	Kōzushima, Izu.		
1249	2	,,	Natsui, Hyūga.	Mitsukuri and Hara	Apr. 13, '96.
1250	1	,,	Shimabira, Satsuma.	,,	Apr. 18, '96.
1252	2	,,	Mizoe, Hyūga.	,,	Apr. 2, '96.
1633	1	,,	Koajiro, Misaki.	Ago	Aug. 18, '99.

Sci. Coll., Spec. No.	Number of individuals	Preservation	Locality	Collector	Date
1034	3	Alc.	Kataura, Satsuma.	Miyajima	Jul. 26, '99.
1253	1	„	Shimo-Koshiki Shima, Satsuma.	„	Jul. 20, '99.
1254	5	„	Hosojima, Hyūga.	Terasaki	Mar. 15, '99.
1255	3	„	Enoura, Suruga.	Mitsukuri	Apr., '84.
1256	3	„	Hōjō Bay, Bōshū.	Iwakawa	Apr., '97.
1257	2	„	Shimo-Koshiki Shima, Satsuma.	Miyajima	Jul. 20, '99.
1267	3	„	Kōzushima	Aoki	May, : 01.
1268	7	„	Hyūga	Kishinouye	Nov. 11, : 01.
1281	1	„	Satamura, Kagoshima Prefecture.	Higashi	
1282	1	„	Koajiro, Misaki.	Mitsukuri	Apr. 22, : 00.
1284	1	Formal.	Izusan, Izu.	Hatta	Jul. 23, : 02.
1294	1	Alc.	Hahajima, Ogasawara Is.	Yoshiwara	Summer, : 01.
1297	Several	„	Manjuyod, S. Negros, Philippines.	B. Dean	Feb., : 01.
1298	1	„	Sanbondake, near Kōzushima	Aoki	Jun. 15, : 00.
1394	4	„	Koajiro, Masaki.	Oka	Aug. 10, '89.

Description :—Tentacles 20, with branches given off not only at the top but sometimes somewhat lower down, approaching in appearance those of a dendrochirote form.

Color reddish brown to blackish brown; ventrum mostly lighter than dorsum. Often small light spots on the dorsum corresponding to papillæ. Tentacles often black.

Very numerous pedicels on the ventrum; sparsely scattered papillæ on the dorsum. In well preserved specimens (No. 1267), pedicels in the three ventral, and papillæ in the two dorsal ambulacral, zones. End-plates of pedicels large (0.8 mm.) same of papillæ very small and imperfect.

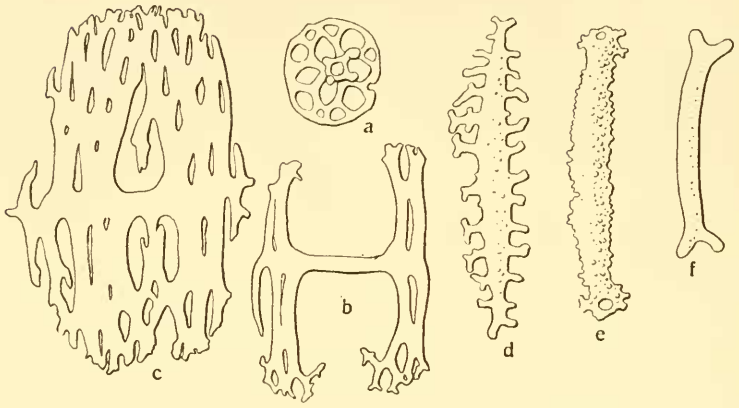
Radialia of calcareous ring very large compared with the interradialia. Polian vesicle single, in the left ventral inter-

ambulacrum. A bundle of several (up to 13 or more) stone-canals on each side of the dorsal mesentery. A bundle of very numerous fine Cuvierian tubes about 3 mm. long, on the basal common part of the respiratory tree.

One specimen measured in life 21.5 cm. When contracted, naturally much smaller, ± 8 cm. long. Skin flaccid and soft to the touch.

I have been able to make out very interesting changes in the calcareous deposits of this variety according to age. I shall begin with a description of the deposits in fully grown individuals. These have been already characterized by Ludwig, but I find some differences in details. The most characteristic and most numerous elements among them are the flat, sometimes more or less bent, granulated rods (textfig. 19 *e*—*f*). Their sizes are 0.100×0.024—0.120×0.024 mm. Most frequently their entire surface is finely granulated; but often the granulation may disappear, and then the rods appear smooth. Along their edge on both sides, they send out short simple processes. Very often these processes bifurcate and may unite with similar neighboring processes, producing a series of small holes near the edge. All these characters appear in various combinations and permutations. Among these smooth rods are occasionally found. Ludwig states that smooth rods are found only on the ventral perisome, but if what I call smooth rods are the same as what Ludwig refers to, they are found also in the dorsal. They are entirely smooth, and much smaller than granulated rods. Their size is at the most ± 0.10 mm., and may be 0.07—0.06 mm. Typically spindle-shaped, they may sometimes be simple rods, or such with the two ends slightly bifurcated. They are never numerous; on the contrary, they

are few and far between, so that they may easily be overlooked. It was a long time before I was sure of their presence. I am still doubtful whether in some specimens



Textfig. 19.

Holothuria lubrica var. *mœbii*: *a*—Tallе; *b*, *c*—H shaped bodies; *d*—*f*—Granulated rods. (×300).

they may not be entirely absent. As I have stated above, I can not be sure whether they are the smooth rods referred to by Ludwig in his description of *H. mœbii*, for he does not mention their size or frequency. I see no reason, however, for assuming them to be different, and in Ludwig's specimens they may have been somewhat more abundant than in mine.

In the wall of the ventral pedicels, close to the end-plates, are found H-shaped supporting rods as described by Ludwig (*b*, *c*). These I have found in all the adult specimens except those from Shimo-Koshiki, Satsuma (No. 1257). The said bodies we may consider as characteristic of var. *mœbii*. Besides them there are sometimes more open supporting rods.

In addition to the three kinds of deposits above mentioned, there occur very slender, small, fine, non-granulated rods with at

the most a few short teeth along the sides. Such rods are found especially in the dorsal papillæ.

The above four kinds of calcareous deposits we may consider as appertaining to fully grown var. *mœbii*. But there are some striking facts brought out when we examine the young. Among the numerous specimens from Kominato (No. 1244) there are some young. Examination of the two smallest, respectively 2.3×0.8 cm. and 3.5×1.0 cm., shows that these contain granulated rods as usual, but smooth rods I have not succeeded in detecting. They have no H-shaped bodies. Of tables they have a few. These mostly consist of the disk alone, sometimes large and sometimes with only the central holes. They are found in both the dorsum and the ventrum, but more frequently in the former. They are never present in any large number, and may easily be overlooked. They are different from those of *H. cinerascens*. In a somewhat larger (5.5×2.4 cm.) specimen from Kominato (No. 1244 *f*), and in another from Natsui (No. 1249, 4.0×1.3 cm.), there are granulated rods and a few tables, but not the H-shaped bodies. Curiously enough, that specimen from Kominato possesses some well-developed tables with tall spire. This is built of four slender pillars with 1—3 cross-beams, but is without a special crown. In a Kominato specimen (No. 1224 *d*) of 7×2 cm., I was able to detect just one table in an area of about one square centimetre, so that tables may remain here and there even in tolerably large specimens.

Remarks :—If we now tabulate the results brought out above, they will appear thus :—

Name	Specimen Number	Sizes in cm.	Tables	Smooth rods	Granulated rods	Slender rods	H-shaped bodies
H. lubrica var. *mœbii* (young)	1244 *c*	2.3×0.8	×	× ?	×	?	0
	1244 *b*	3.5×1.0	×	0 ?	×	×	0
	1249	4.0×1.3	×	×	×	×	×
	1244 *f*	5.5×2.4	×	×	×	×	×
	1244 *d*	7.0×2.0	× 1 in 1 sq. cm.	×	×	×	×
„ (adult)			0	×	×	×	×
„	1257		0	×	×	?	0
H. willeyi			×	×	×	?	0
H. glaberrima			0	0 ?	×	?	0
H. lubrica			0	0 ?	×	?	0
H. marenzelleri			0	0 ?	×	?	0

The above table shows clearly that in the young, tables (although few) and rods (probably both granulated and smooth kinds) are present; but no H-shaped body is present. As the animal grows older, the tables diminish in number, and the H-shaped bodies are produced. With still further growth, tables disappear and there are present only rods and H-shaped bodies. This change had already been suspected by SEMPER, as may be seen from what he says in regard to certain five young individuals which he places among *H. crinaceus* var. *pygmæa* (=*H. glaberrima*=*H. lubrica*). He says: " ..... ausserdem aber besassen sie sehr vereinzelt stehende Stühlchen (Taf. XXX., Fig. 23 *b*), deren Scheibe ziemlich unregelmässig gebildet war und nur einen rudimentären Stiel besass. Was mich bestimmt, diese jungen Thiere dennoch als dieser Varietät zugehörig anzusehen, ist ausser den gleichen Fundort und der sonstigen vollkommenen Übereinstimmung, die Thatsache, dass das kleinste kaum 1 cm. lange Thier die Stühlchen in bedeutenderer Menge zeigt, als die nächst grösseren, und dass das 3 cm. lange Individuum ihrer schon entbehrt. Allerdings

ist das untersuchte Material zu geringfügig, um mit Entschiedenheit eine solche Aufeinanderfolge der Kalkkörper in der Entwicklung des Individuums behaupten zu können; doch macht die sicher constatierte Beobachtung Baur's von dem analogen Vorgange bei *Synapta digitata* eine solche Deutung der oben angegebenen Thatsachen jedenfalls sehr wahrscheinlich" (Semper 1867—8, p. 92).

Also Ludwig says of *H. lubrica* (1887*a*, p. 4):—"Bei dem kleinsten, nur 1.5 cm. langen Exemplare finden sich aber ausserdem in der Nähe der Endscheibchen der Füsschen auch noch durchlöcherte Kalkgebilde, welche zwar kleinen Aufsatz haben, sonst aber an die von Semper bei seiner *H. erinaceus* var. *pygmaea* beschriebenen und abgebildeten Kalkkörper erinneren." Here it is evident that Ludwig too observed the presence of tables or at least of their disks in the young of *H. lubrica*.

I think there is hardly any question that the specimens I have examined belong to *H. moebii* Ludwig. At any rate, I do not feel justified in establishing a new species, as there is no substantial ground to build it on. There can also be no doubt that it is closely allied to *H. lubrica* and other related species as was pointed out by Théel. The only point of difference besides that in the arrangement of stone canals, is the fact that there are H-shaped supporting rods in *H. moebii*. But even these may sometimes be absent as in the specimens from Koshiki (No. 1257). It may be supposed that these specimens do not belong to *H. moebii* but to some other species. But a careful dissection shows that they are exactly like the other specimens of *H. moebii*, so that I do not feel justified in specifically separating it from them. At the same time, the absence of H-shaped bodies and the shape of the rods make them identical with *H. glaberrima* Selenka or *H. marenzelleri* Ludwig.

All these facts have puzzled me considerably, and the best and most satisfactory solution seems to be the following assumption: —There is a very extensive species which by reason of the law of priority ought to be called *H. lubrica* Ludwig. This has produced or is in the process of producing local varieties with many intermediate forms. As belonging to the species indicated I consider the following varieties :—

(1) var. *moebii* (Ludwig)

Literature given above.

Locality :—Hongkong (Ludwig '83) ; Mauritius (Théel '86).

(2) var. *glaberrima* (Selenka).

Holothuria glaberrima Selenka 1867, p. 328, Taf. XVIII., Figg. 57, 58.—Semper 1867—'68, pp. 92, 279.—Lampert 1885,p. 90.—Théel 1886*a*, p. 205.—Sluiter 1895, p. 78.—Lampert 1896, pp. 56—59.—Ludwig 1898*b*, p. 434—Clark 1901*b*, p. 258.

Locality :—Hayti (Selenka '67) ; Bahama (Selenka '67) ; Panama (Selenka '67) ; Port Rico (Clark : 01) ; Surinam (Semper '67—'68) ; Savanilla, St. Thomas (Lampert '85) ; Caracas (Lampert '85) ; Nord See (Sluiter '95).

It is acknowledged by all that *H. erinaceus* Semper with its variety *pygmæa* is identical with *H. glaberrima*. I append here its literature and distribution :—

Holothuria erinaceus Semper 1867—'68, pp. 91, 250, 279, Taf. XXX., Fig. 24, Taf. XXXIV., Fig. 9, Taf. XXXV., Fig. 14, Taf. XXXVI., Fig. 11, Taf. XXXVIII., Figg. 1, 2. Lampert 1885, pp. 90—91.—Théel 1886*a*, p. 206.—Sluiter 1887, pl. 186.—Sluiter 1895, p. 78.—Lampert 1896, pp. 56—59.—Ludwig 1898*a*, p. 434.

Holothuria erinaceus var. *pygmæa* Semper 1867—'68, pp. 91—92, Taf. XXX., Figg. 23—24.—Lampert 1885, pp. 90—91.—Théel 1886*a*, p. 206.

Locality :—Bohol (Semper '67—8) ; Viti (Semper '67—8) ; Albay, Luzon (Semper '67—8) ; Port Mackay, N. E. Australia (Semper '67—8) ; Fiji (Théel '86); Sunda Strait (Sluiter '87); Amboina (Sluiter '95); Cocos I. (Sluiter '95).

(3) var. *lubrica* (Selenka).

Holothuria lubrica Selenka 1867, p. 329, Taf. XVIII., Figs. 59—60.—Semper 1867—'68, pp. 92, 251, 279.—Ludwig 1882, p. 137.—Lampert 1885, p. 90.—Théel 1886*a*, p. 205.—Théel 1886*b*, p. 7.—Ludwig 1887*a*, p. 4.—Ludwig 1889—'92, p. 330.—Lampert 1896, pp. 56—59.—Ludwig 1898, p. 435.—Ludwig 1899, p. 560.—Sluiter 1901*b*, p. 8.

Locality :—Acapulco (Selenka '67); Mazatlan (Semper '67—8, Théel '86); Sanghir, Moluccas (Ludwig '82); Amboina (Lampert '85); St. Bartholomew (Théel '86); Saleyer (Sluiter : 01); Labuan Pandan (Sluiter : 01); Labuan Badjo (Sluiter : 01); Damner (Sluiter : 01).

(4) var. *parva* (Krauss).

Holothuria parva Lampert 1885, p. 246, Fig. 38.—Théel 1886*a*, p. 264.—Lampert 1896, pp. 56—59.—Ludwig 1899, 560.

Locality :—Natal (Lampert '65); Ras Muhesa bei Pangani (Lampert '96); Bawi, Zanzibar (Ludwig '99).

(5) var. *marenzelleri* (Ludwig).

Holothuria marenzelleri Ludwig 1883, pp. 167—8.—Lampert 1885, p. 91.—Théel 1886*a*, p. 207.—Théel 1886*b*, p. 8.—Ludwig 1887*a*, p. 2, Taf. II., Fig. 12.—Ludwig 1887*b*, p. 1229.—Sluiter 1887, p. 186.—Ludwig 1888, p. 810.—Ludwig 1889—'92, p. 330.—Sluiter 1894, p. 104.—Sluiter 1901*b*, p. 7.—Clark 1902*b*, p. 528.

Holothuria andersoni Bell 1886, p. 28.

Locality :—Nangkauri (Ludwig '83, Théel '86); Mergui (Bell '86); Galapagos (Ludwig '87, Théel '86, Clark : 02); Sunda Strait (Sluiter '87); Pulo Edam (Ludwig '88); Noordwachter Eiland (Ludwig '88); Amboina (Sluiter '94); Labuan Pandan (Sluiter : 01); Bima (Sluiter : 01); Labuan Badjo (Sluiter : 01).

To judge by Ludwig's figures (1887*a*), this form is nothing but *H. lubrica* with very broad rods. Among the specimens of *H. mœbii* in my possession there is a considerable range of

variation in the width of the rods, and some of the broad ones approach those of this variety figured by LUDWIG.

There can be no doubt that *H. kapiolanie* BELL from the Sandwich Is. ought to be placed in *H. lubrica*. Whether it belongs to one of the above varieties, or constitutes a distinct variety, I have no means of ascertaining.

H. willeyi BEDFORD from Blanche Bay, New Britain, described from two specimens respectively 2.2 cm. and 1.7 cm. in length, is undoubtedly the young of some form belonging to this species. Like the young animals I have studied (see above), they had granulated rods (up to 0.125 mm.), smooth rods (up to 0.1 mm.) and a few scattered tables with reduced spire, but lacked the H-shaped supporting rods.

It will be seen from the above list of localities that each variety, as a matter of general fact, has its own region of distribution. There are probably two reasons for this: 1) these varieties are more or less local as I have stated above, and 2) the determination by each investigator has been more or less influenced by the identification of previous authors.

25. *Holothuria macleari* BELL.

(Textfig. 20).

Holothuria macleari BELL 1884, p. 152, Pl. IX., fig. G.—LAMPERT 1885, p. 74.—THÉEL 1886*a*, p. 218.—LUDWIG 1889—'92, p. 330.

Specimens examined :—

Sci. Coll., Spec. No.	No. of individuals	Preservation	Locality	Collector	Date
1234	5	Alc.	Dead coral reef, No-i Bise, Nakagusuku Bay, Okinawa.	Mitsukuri, Ikeda & Kuroiwa	Apr. 16, : 01.
1235	2	,,	Dead coral reef below Nami-no-Uye Temple, Naha, Okinawa.	,,	Apr. 8, : 01.
1236	1	,,	Dead coral reef, Ohomine near Naha, Okinawa.	,,	Apr. 9, : 01.
1237	17	,,	Dead coral reef, Okaha, off Itoman, Okinawa.	,,	Apr. 11, : 01.
1242	1	,,	Moroka, Chichijima, Ogasawara Is.	Hirota & Sekiguchi	Feb.—Apr., '94.
1273	2	,,	Naha, Okinawa.	Miyajima	May 25, : 00.
1276	4	,,	Manjuyod, South Negros, Philippines.	B. Dean	Feb. : 01.
1288	1	,,	Hahajima, Ogasawara Is.	Yoshiwara	Summer, : 01.

Description :—" The spicules of this species present a considerable resemblance to those of *H. tigris*, with which, as it would seem, it must be closely allied. As there is but a single specimen, presenting well-marked external characters, I think it right to limit myself to an account of these. Body elongated, trivium flat, bivium convex, anus round, unarmed, without (perhaps having lost) any distinct indications of pentamerous marking ; ambulacral papillæ on the convex back, three rows of not very regularly arranged suckers on the trivium. An appearance of ringing both above and below is produced by the white colours and transverse setting of the papillæ and suckers respectively ; as the former are less numerous than the latter, there are only about thirty bivial rings, while on the trivium two or three rings are here and there confluent and present a kind of longitudinal marking. The single specimen is 49 mm. long and 10 mm. wide." (Bell 1884).

Remarks :—It is not without some misgiving that I identify

these specimens with *H. macleari* BELL, the description of which leaves much to be desired. But the calcareous bodies, so far as described by BELL, and the characteristic markings agree so closely with it that I feel justified in putting these specimens in the species named.

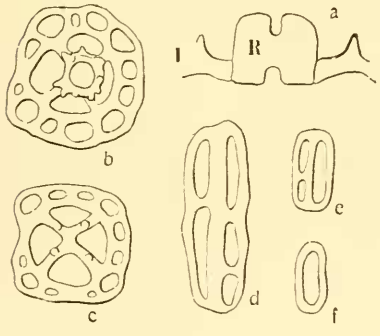
Tentacles 20, yellow. In the present contracted state, the largest specimen measures 5×2 cm. and the smallest 2.3×1 cm. In the living state, they were much larger and more slender. The one I figured while living was 9×1 cm.

Pedicels on the ventrum, papillæ on the dorsum: the former more numerous than the latter. When contracted, it is possible to make out that both are placed on the ambulacra. On the dorsum, there are two rows of the papillæ on each of the dorsal ambulacra. On the ventral median ambulacrum there are two rows of pedicels, which appear more crowded in alcoholic specimens. On each of the lateral ambulacra, which mark the boundary of the dorsal and ventral surfaces, there are again two rows, of which one row consists of papillæ and the other of pedicels. When living and stretched out, it is difficult to make out these rows, the appendages appearing as if irregularly scattered over the ambulacra as well as the interambulacra.

The ground color is chestnut brown, which changes into dark chestnut when the animal is contracted in alcohol. The ambulacral appendages are white, each being surrounded at base by a whitish area which gradually merges without any sharp demarcation into the surrounding chestnut color. The tip of the appendages is straw yellow. The white areas that mark the appendages are very conspicuous, especially on the dorsum. In contracted alcoholic specimens these are seen to be arranged in longitudinal rows as well as in transverse rings, an appearance which, I take

it, is that referred to in Bell's description. In life the appendages are longitudinally elongated but in alcohol transversely elongated, as described by Bell. This seems to be a difference due merely to the state of contraction.

There are three kinds of calcareous bodies. (i) Tables in a very closely arranged layer (textfig. 20 *b*, *c*). They have a disk with smooth margin. Around the large central opening there is a very neat circle of small holes, ± 12 in number. Of these the four in the radii of the spire-pillars are often larger than the others. The size of the disk 0.05—0.06 mm. The spire is built of four pillars with one cross beam. The crown has ± 12 teeth. (ii) Buttons in a layer below that of the tables. Most numerous are the regularly shaped buttons with three pairs of holes (*d*). Some others show four or five pairs of holes. Some more or less crenate in the margin, others not. Not uncommonly the holes are asymmetrically present in that either one or more of them on one side have run together, or one is altogether without a vis-à-vis on the opposite side. The buttons measure 0.06—0.076 mm. in length. The above tables and buttons must be considered as agreeing well with those given in Bell's figures. (iii) Below the above mentioned two layers, in the under skin, there are somewhat sparsely scattered, much more minute buttons, only 0.02—0.036 mm. in size. They are sometimes mere oval rings (*f*), but more frequently show a



Textfig. 20.

Holothuria macleari: *a* — Calcareous ring; *b*, *c*—Tables; *d*—Button; *e*, *f*—Small imperfect buttons. (*b*—*f* × 300. I—Interradialia; R—Radialia.

pair or so of openings (*e*). These minute buttons are not mentioned by BELL, but as they are placed much deeper than the tables and ordinary buttons, they might easily be overlooked, and were probably not noticed by BELL.

The supporting rods of the pedicels and papillæ are large button-like plates and slender dendritic rods. Ventral pedicels are supplied with large, and dorsal papillæ with small, end-plates.

Reproductive organs are present on the left side only; they were still very small in the specimen examined. Polian vesicles three, of which one was filiform and the other two more or less club-shaped, the largest being 1.5 cm. long. Stone-canal single; dorsally situated on the right of the dorsal mesentery, with a pea-shaped madreporic body. Cuvierian organ was a bundle of unbranched finger-like tubes attached to the stem of the respiratory tree. Calcareous ring as shown in textfig. 20 *a*, the radial pieces being 2 mm. high.

The above species is close to *H. oxurropa* SLUITER. But in the latter species, the arrangement of ambulacral appendages in regular rows can be detected neither on the dorsum nor on the ventrum, the appendages are without white areas around the base, and the dorsal papillæ lack calcareous deposits except small end-plates; while in my specimens of *H. macleari* they are covered with numerous tables and buttons, the stone-canal is attached, and Polian vesicles are 8—12 in number.

This species also closely resembles *H. infesta* SLUITER in having three kinds of calcareous bodies, but in that species, the innermost layer consists of slender rods slightly thorny at the ends. Further, the species show close resemblance to *H. lamperti* LUDWIG, *H. curiosa* LUDWIG and *H. fusco-lubra* THÉEL. I should

not be surprised if some of these names should turn out to be synonyms of *H. macleari*.

Locality :—Clairmont and Bird Is. (Bell '84); Rodriguez I. (Bell '84); Okinawa I.; Ogasawara Is.; Philippine Is.

26. *Holothuria maculata* (Brandt).

Sporadipus (*Acolpos*) *maculatus* Brandt 1835, pp. 46—47.—Ludwig 1881*a*, p. 595.

Holothuria maculata Selenka 1867, p. 331.—Ludwig 1883, p. 168.—Lampert 1885, p. 73, Fig. 6.—Bell 1887*a*, p. 140.—Ludwig 1887*a*, p. 2.—Bell 1888, p. 389.—Ludwig 1888, p. 807.—Ludwig 1889—'92, p. 330.—Ludwig 1893, p. 7.—Herouard 1893, p. 133, Pl. VII., Fig. B.—Sluiter 1895, p. 79.—Lampert 1896, p. 54.—Mitsukuri 1896, p. 407.—Bedford 1899*a*, p. 842.—Ludwig 1899, p. 561.—Bedford 1899*b*, p. 146.—Sluiter 1901*b*, p. 9.

Holothuria arenicola Semper 1867—'68, pp. 81, 277, Taf. XX., Taf. XXX., Fig. 13, Taf. XXXV., Fig. 4.—Haacke 1880, p. 46.—Théel 1886*a*, p. 222.—Théel 1886*b*, p. 7.—Sluiter 1887, p. 191.—Clark 1902*b*, p. 528.

Specimens examined :—

Sci. Coll., Spec. No.	No. of individuals	Preservation	Locality	Collector	Date
1032	2	Alc.	Susaki, Chichijima, Ogasawara Is.	Hirota & Sekiguchi	Apr. 26, '94.
1270	2	„	Okaha Reef off Itoman, Okinawa, among dead coral reefs.	Mitsukuri, Ikeda &c.	Apr. 11, : 01.
1271	1	„	Dead coral reefs, Ohomine, near Naha, Okinawa.	„	Apr., 9, -: 01.

Description :—" 20 sehr kurze, fast an die der Dendrochiroten erinnernde Tentakel. Körperform cylindrisch, vorne nur sehr wenig, hinten etwas mehr verjüngt. After mit 5 Gruppen von Papillen, fünfstrahlig." (Semper p. 81). " Pedicels all over the body." (Théel p. 222). " Grundfarbe schmutzig geblichgrau, mit

2 Reihen die beiden Radien des Rückens bezeichnender brauner verwischter Flecken, oder gleichmässig über den ganzen Körper mit dunkelbraunen Pünktchen versehen. Die 5 Muskel schimmern mattweiss durch die Haut hindurch." (SEMPER p. 81). "Colour light yellowish-grey, with a row of distant darkish-brown spots along each dorsal ambulacrum; also some minute scattered spots." (THÉEL p. 222). "Die Kalkkörper der Haut sind Stühlchen und Schnallen von der gewöhnlichen dieser Gruppe zukommenden Form." (SEMPER p. 81). "The tables have the smooth disk pierced by a larger central hole and several small peripheral ones; their spire is built up of four rods and one transverse beam, and terminates in several teeth. The oval buttons regularly with six holes..... The tables.....have not the nine nearly equal holes in the disk, which on the contrary is perforated by a large central hole and a varying number of small peripheral holes. The spire terminates in twenty or more teeth. The buttons are very symmetrical, as a rule with six holes..... The supporting rods of these pedicels are smooth, slightly enlarged, and perforated at the middle and the ends. All the ambulacral appendages have end-plates." (THÉEL p. 222). "Der Wassergefässring liegt hier weiter vom Kalkring ab, als bei irgend einer andern mir bekannten Holothurie, nämlich bei einem in Spiritus 16 Cm. messenden Exemplar 2 Cm. weit. Am Wassergefässring eine sehr kurze Polische Blase, und einziger noch kürzerer dorsaler Steincanal. ..... Bei einem der Exemplare von Amboina sass eine einziger kleiner CUVIER'scher Schlauch am Grunde der Lungen, in den übrigen von mir untersuchten Individuen konnte ich keine auffinden." (SEMPER p. 81). "Es leben die Tiere hier..... im Sande..... Die Vermutung THÉEL's dass *H. arenicola* und *H. fusco-cinerea* sehr nahe verwandt seien, ist wohl

für jeden, der die beiden Tiere im Leben vor sich gesehen hat, kaum wohlbegründet, da sowohl Lebensart, Farbe als ganzer Habitus beider Tiere sehr verschieden sind, so wie auch die Tentakel, und mehr oder weniger die Kalkablagerungen." (SLUITER 1887, pp. 191—2).

Remarks :—The specimens before me are about 8 cm. long, being much contracted as indicated by numerous transverse wrinkles on the body. They have a grayish brown ground color, and along each of the dorsal ambulacra there is a series of irregular dark brown spots about $\frac{1}{2}$ cm. across. Besides these, there are numerous minute spots of the same dark brown color, scattered all over the body. In one specimen, some spots on the ventrum are of a somewhat large size instead of all the spots being minute. Tentacles small, dark brown on the outer face. All the ambulacral appendages, those on the dorsum as well as those on the ventrum, have well-developed end-plates. They are therefore all pedicels.

The circular ambulacral vessel is situated quite far back, being 12 mm. apart from the calcareous ring, in agreement with SEMPER's statement. A single Polian vesicle, about 13 mm. long; and one very much smaller dorsal stone-canal on the right of the mesentery. Reproductive organ somewhat developed, being over 7 cm. in length. In one specimen, at the base of the left respiratory tree, a branch of very slender Cuvierian bodies about 7 mm. in length and less than 1 mm. in breadth. Calcareous bodies as described by THÉEL.

Locality :—Suez (HEROUARD '93); Kosseir (LAMPERT '85); Zanzibar (LAMPERT '85); Insel Changu, Zanzibar (LAMPERT '95); Seychelles (LUDWIG '99); Mauritius (HAACKE '69, LUDWIG '83); Bay of Bengal (BEIL '88); Andaman Is. (BELL '87); Pulo Pandan (SLUITER '87); Pulo Edam (LUDWIG '88);

Moluccas (Sluiter '95); Amboina (Semper '67—8, Ludwig '88); Bohol (Semper '67—8); Ogasawara Is. (Brandt '35); Pepela Bay, Rotti (Sluiter : 01); Sanana Bai, Sula Besi (Sluiter : 01); Marshall Is. (Lampert '85); China Strait, New Guinea (Bedford '99); Lifu, Loyalty Is. (Bedford '99); Funafuti (Bedford '99); Fiji (Semper '67—8); Samoa (Théel '86); Charles I., Galapagos Is. (Théel '86); Galapagos (Clark : 02); "Albatross" Stat. 3368 (Ludwig '93); Panama, West Coast (Ludwig '87); Surinam (Semper '67—8); Bahia (Lampert '85); Ogasawara Is.; Okinawa I.

27. *Holothuria marmorata* (Jaeger).

(Textfig. 21).

Bohadschia marmorata Jaeger 1833, p. 18, Taf. III, Figs. 9—10.—Selenka 1867, p. 320.

Sporadipus (*Colpochirota*) *ualensis* Brandt 1835, p. 56.

Holothuria brandtii Selenka 1867, p. 339.

Holothuria ualensis Selenka 1867, p. 341.

Holothuria marmorata Semper 1867—'68, pp. 79, 227, Taf. XXX, Fig. 10, Taf. XXXV, Fig. 3. Taf. XXXVI, Fig. 8, Taf. XXXVII, Figs. 1—4.—Selenka 1868, p. 118.—Ludwig 1881, p. 594.—Ludwig 1882, p. 135.—Ludwig 1883, p. 168.—Lampert 1885, p. 86.—Théel 1886*a*, p. 202.—Sluiter 1887, p. 185.—Bell 1887*b*, p. 145.—Ludwig 1888, p. 806.—Bell 1888, p. 385.—Ludwig 1889—'92, p. 33.—Kent 1893, p. 236.—Sluiter 1894, p. 103.—Sluiter 1895, p. 78.—Mitsukuri 1896, p. 408.—Sluiter 1901*b*, p. 12.

Holothuria utrinquestigmosa Haacke 1880, p. 48.

Specimens examined :—

Sci. Coll., Spec. No.	No. of individuals	Preservation	Locality	Collector	Date
1216	1	Alc.	Jishaka Reef; Naha, Okinawa.	Mitsukuri	Apr. 17, : 01.
1047	1	,,	Liu-Kiu Is. (?)		
1306	1	Dried	Torres Strait.		

Description :—Tentacles 20, white; shields somewhat dark. Length from 4—6 inches to 1 foot (120 mm. Théel). "Dorsum fuscocinereum maculis rotundato-angulosius, intensius coloratis marmoratum. Hac maculæ, in variis variæ individuis, ad dorsi latera inprimis conspiciuntur. Venter albidus dilute fuscocinereus" (Jaeger pp. 18—9). "Thier weizengelb, auf dem Rücken mehrere grosse, unregelmässige braunviolette Flecke" (Selenka 1867 p. 339). "Im Leben ist die Grundfarbe des Rückens gelblichgrau, die Flecken sind sehr unregelmässig und ziemlich dunkelbraun" (Semper p. 79). "Dorsal surface auburn, with some large spots or bands of yellowish-white colour, ventral surface yellowish-white; here and there, especially along the sides of the body, a large darker violet spot may be found within a light yellowish space. The ambulacral appendages have the shape of cylindrical pedicels, which, however, are smaller on the dorsal surface. These pedicels are supported by a well-developed terminal plate and numerous transverse rods. Scattered among the dorsal pedicels other ambulacral appendages may be seen, which, being slightly larger than the dorsal pedicels themselves, present an obvious conical form, and may evidently be regarded as papillæ. These papillæ are supported by a great number of rods, but their terminal plates are very reduced." (Théel pp. 202—3). According to Selenka, the pedicels have the end-plate but are entirely without supporting rods. "Füsschen ohne Stützstäbe, aber mit ästigen Körpern" (Lampert p. 87). "Die Kalkablagerungen der Haut bestehen ausschliesslich in rundlichen Ellipsoiden, auf der Bauchseite von 0,02 Mm. Grösse, auf dem Rücken, von 0,005 Mm. Durchmesser; durch Verwachsung dieser Körnchen entstehen oft hantel- oder biscuitartige Formen" (Selenka 1867, p. 339). Semper figures very irregular, rather thick rosettes (Taf. XXX Fig. 10). Accord-

ing to THÉEL, "The rosettes in the body-wall itself are mostly very incompletely developed, either resembling simple X-shaped bodies, or oval grains with incisions at their middle, or rounded grains with or without perforations, or even rods with a series of rounded prominences on each side" (p. 203). Of the same bodies LAMPERT says: "Krause und rosettenförmige Körper. In der Bauchhaut rundliche Ellipsoide." Skin soft to the touch. Anus stellate, owing to 5 groups of small papillæ: sometimes not distinctly stellate. Polian vesicles 1—5, or 7. Stone-canal very small, attached to the mesentery. Cuvierian organs present.

Remarks:—At least two of the specimens before me may, I think, with a great degree of certainty be identified as belonging to this species. Sepecimen No. 1216 was collected by myself and observed while living and is now in a very good condition of preservation. Therefore the following description for the most part is founded on it.

When living, it was 40 cm. long and 14 cm. broad. In the present contracted state, it is 27×9 cm. large. Dorsum and ventrum are very differently colored. The ground color of the former is brown. It becomes darker or lighter according to the state of contraction. On this are scattered many large irregular patches of ochre-yellow color without any regularity of occurrence. The smaller of these patches are circular in shape, being as small as 0.5 cm. in diameter. The larger ones may measure several centimeters across and are of an irregular amœboid shape, many of them appearing as if formed by the running together of smaller circular patches. The patches show a thin well-defined rim of dark brown chestnut around the ochre-yellow central area. In the small circular patches a padilla, somewhat larger than the ordinary pedicels, rises from the centre. Such patches therefore look

like the eye-spots of *H. argus*, but here the outer brown rim is a well-defined line, instead of shading off gradually centripetally; moreover, there is no central dark spot. In the largar patches, there may be a papilla in the centre of each component circle, but in the very largest, it is not possible to observe the papillæ. The patches along the edges of the dorsum are more or less circular, measuring 1—2 cm. in diameter, and on the whole form a row on each side. In general, the dorsum looks like the map of an archipelago consisting of numerous large and small islands of all shapes, and well supports the name *marmorata*.

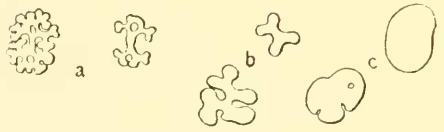
On the ventrum the ground color is white. There is an ill-defined longitudinal band of a dark sooty color occupying about one-third of the ventrum. In this streak, surrounded by white spaces, are yellow-ochre patches of the same type as on the dorsum but generally of only small sizes. Of these there are roughly speaking two longitudinal rows, one on each side of the median line. Outside of the sooty band, there is on each side an irregular row of the same patches, closely bordering on the darker dorsum. These lateral rows consist on the whole of larger patches than those near the median line, most of them being about 1 cm. across. The patches on the ventrum show no central papilla.

In alcohol, the colors are arranged as in the living specimen, but the ground color of the dorsum has acquired a purplish tinge. The ochre-yellow patches now appear dark-brown or mars-brown, and those on the sides are more conspicuously visible than those on the more dorsal parts, as the white of the ventrum seems to extend around those patches and make them stand out distinctly. In the macerated specimen (No. 1047) the colors are much faded, and the irregular patches appear light on the general auburn

ground color.

The ambulacral appendages are very numerous, being distributed all over the body without any regard to the ambulacra or to the colored patches. The dorsal pedicels and many of the ventral ones have the tip colored black in life, although this color fades in alcohol. The pedicels all have well-developed end-plates: those of the dorsal pedicels seem, however, to be on the whole smaller than those of the ventral ones. The walls of the pedicels have, mixed with other calcareous bodies, supporting rods in the shape of simple rods which may be more or less curved, with their ends enlarged or slightly branched. They may attain a length of 0.10—0.20 mm. The papillæ that have been described above as rising from the centre of the dorsal yellow patches are conical and have no end-plates, or at the most very weakly developed ones consisting of a few meshes of calcareous network. The papillæ have very numerous supporting rods. I am thus able to confirm THÉEL's observations on this point.

Calcareous deposits differ very much in the dorsal and ventral perisome. Those in the latter agree with the description of THÉEL. They may be X-shaped (textfig. 21*b*) or of a simple biscuit-like or ellipsoidal shape with or without perforations (*c*). Besides these there exist more or less highly developed rosettes. I am inclined to think that SEMPER's figures (Taf. XXX., Fig. 10) probably represent some of the better developed rosettes. The calcareous bodies in the dorsal perisome are of a more gracile appearance than those in the dorsal peri-



Textfig. 21.

Holothuria marmorata: *a*—Rosettes; *b*—X-shaped bodies; *c*—Biscuits or oval grains. (×300).

some, consisting almost exclusively of delicate filigree-like rosettes (*a*).

Anus with five groups of small papillæ. Shields of tentacles somewhat dark.

This is one of the commonest and at the same time most ambiguously defined species. Almost every writer differs materially from others in characterizing some of the important features. This is probably due to the fact that this species is evidently a very extensive one, presenting many forms of variation, which different authors have seized for their respective descriptions. Also some of these phases may have been described as different species. THÉEL goes so far as to think—with much show of reason I believe—that *H. marmorata*, *H. argus*, *H. vitiensis*, *H. tennissima*, *H. köllikeri*, *H. clemens*, *H. similis* are probably only young or varieties of one, or at the most, of two or three species. Of this, however I shall have more to say at another place.

Locality :—Mauritius (HAACKE '80, LUDWIG '83, THÉEL '86); Myotte (SLUITER '95); Andaman Is. (BELL '87); Tuticorin, Madras (BELL '88); Nicobar Is. (SEMPER '67—8); Batavia (SLUITER '95); Pulo Edam (LUDWIG '88); Insel Edam, Bai von Batavia (SLUITER '87); Insel Noordwachter (SLUITER '87); Cocos Is. (SLUITER '95); Java (SELENKA '67); Celebes (JAEGER '33, LAMPERT '85); Bohol, Philippine Is. (SEMPER '67—8); Zebu (LAMPERT '85); Ogasawara Is. (SEMPER '67—8); Amboina (LUDWIG '82, '88, SLUITER '94, '95); Ualan, Caroline Is. (BRANDT '35); Fiji Is. (SEMPER '67—8); Geelvink Bay (LUDWIG '82); Great Barrier Reef (KENT '93); South Sea? (LAMPERT '85); Pulu-Passi-Tanette (SLUITER : 01); Kwandang Bai, Pajunga I. (SLUITER : 01); Sonana Bai (SLUITER : 01); Timor (SLUITER : 01); Roma (SLUITER : 01); Okinawa I.; Torres Strait.

28. *Holothuria monacaria* (Lesson).

Psolus monacaria Lesson 1830, p. 225, Taf. LXXVIII.

Holothuria monacaria Jaeger 1833, p. 24.—Selenka 1867, p. 331.—Semper 1867—'68, pp. 78, 276.—Semper 1869, p. 12[illegible].—Ludwig 1882, p. 134.—Ludwig 1883, pp. 155, 165.—Lampert 1885, pp. 72—73.—Théel 1886*a*, pp. 172—3, 217, Pl. VIII, fig. 10.—Bell 1887*a*, p. 140.—Ludwig 1887*b*, p. 1224.—Sluiter 1887, p. 189.—Ludwig 1888, p. 806.—Bell 1888, pp. 385, 389.—Lampert 1889, p. 808.—Thurston 1890.—Ludwig 1889—'92, p. 330.—Sluiter 1894, p. 103.—Koehler 1895*c*, p. 381.—Koehler 1895*d*, p. 281.—Sluiter 1895, p. 77.—Lampert 1896, p. 54.—Bedford 1899*a*, p. 146.—Bedford 1899*b*, p. 841.—Ludwig 1899, p. 557.—Sluiter 1901*b*, p. 11.

Holothuria flammea Quoy et Gaimard 1833, p. 117, Taf. VI, Figg. 5—6.

Holothuria fasciola Quoy et Gaimard 1833, p. 133.—Brandt 1835, p. 74.—Selenka 1867, p. 341.

Holothuria fusco-punctata Quoy et Gaimard 1833, p. 132.—Brandt 1835, p. 75.

Stichopus flammeus Brandt 1835, p. 73.—Selenka 1867, p. 320.

Thelonota monacaria Brandt 1835, p. 55.

Stichopus gyrifer Selenka 1867, p. 319.

Stichopus monacaria Selenka 1868, p. 117.

Labidodemas leucopus Haacke 1880, pp. 46—7.

Labidodemas neglectum Haacke 1880, p. 48.

Holothuria decorata v. Marenzeller 1881, pp. 137—9, Taf. IV. Fig. 12.—Ludwig 1882, p. 135.—Ludwig 1883, p. 116.—Théel 1886*a*, p. 218.—Ludwig 1887*a*, p. 2.—Ludwig 1889—'92, p. 329.—Mitsukuri 1896, p. 407.—Bedford 1899*a*, p. 146.

Holothuria minax Théel 1886*a*, pp. 173—4, Pl. VIII, fig. 8.—Ludwig 1889—'92, p. 330.—Mitsukuri 1896, p. 408.

Specimens examined :—

Sci. Coll., Spec. No.	No. of individuals	Preservation	Locality	Depth in *hiro*	Collector	Date
1036	1	Alc.	Iki I.		Namiye & Tsuchida	Mar. '91.
1037	4	Formal.	Misaki		Mitsukuri	Apr. '99.
1046	4	Alc.	Dōketsuba off Misaki	130	Aoki	Aug. 8, '97.
1211	3	„	Misaki			
1212	6	Formal.	Ōita, Bungo, Kyū-shū.		Terazaki	Mar. 13, '99.
1213	1	Dried	Saganoseki, Bungo, Kyūshū.			
1214	1	Alc.	Hommura, Awaji.		Okada	
1378	2	„	Kominato, Bō-shū.		Ishikawa & Okada	Apr. '85.
A,B,C.	3		Misaki	30		Apr. 6, :02.
Many living specimens observed at the Misaki Marine laboratory.						

Description :—" 20 Tentakel, Bauchfüsschen in 3 Reihen, Rückenpapillen in 4 (indistinct Théel) Längsreihen. Mund von 20, manchmal nicht sehr deutlichen Papillen umgeben " (Lampert 1885, p. 73). " The rounded disk of the tables with a central hole surrounded by from four to twelve peripheral holes. The spire terminates in about twelve teeth or more (16 zackig Lampert). The oval smooth symmetrical buttons with three or four pairs of holes " (Théel p. 217). " 1 Poli'sche Blase, 1 kleiner festgelegter Steinkanal. Cuvier'sche Organe blinddarmförmig. Braun mit schwarzen Flecken, oft mit einem Stich ins Grünliche. Papillen gelb " (Lampert 1885, p. 73). " Papillæ surrounded with white circles " (Jaeger p. 24). " Die thurmförmigen Körper der Haut sind plump, 0,064 Mm. hoch, mit 16-zinkiger Krone ; die flachen und glatten schnallenförmigen durchschnittlich 0,1 Mm. lang, halb so breit, mit acht, selten secks Löchern. In den Wandungen aller Füsschen nahe dem Endscheibchen lagern eine Anzahl durchlöcherter bilateral symmetrischer Kalkplättchen.—Farbe der Ex-

emplare (besides the above mentioned) dunkel braunroth" (SELENKA 1867, p. 319).

Remarks :—This is one of the commonest species of holothurians on the coasts of Japan. It is abundant in Misaki. Some specimens examined by me came also from Kyūshū and from the Island of Iki, in the Japan Sea. The Japanese name is "Fuji-namako" or "Oki-namako."

It will be seen from the list of synonyms given above that I identify *H. decorata* MARENZELLER and *H. minax* THÉEL with this species. As Enoshima, where the original specimens of MARENZELLER were secured, is in the Bay of Sagami with Misaki in sight, I have no doubt that the specimens which I here identify as *H. monacaria* belong to the same species as those on which *H. decorata* of MARENZELLER was established. That writer himself has pointed out the similarity of the two species, but established the new species solely on account of the difference in coloration and habitat. As at the present day specimens which have been identified with *decorata* by competent authorities are known from different localities, and their similarity to *H. monacaria* noted (LUDWIG, THÉEL, BEDFORD), and especially since the similarity of coloration in the two species has been pointed out by BEDFORD (1899*a*), the points on which MARENZELLER established his species disappear. It seems MARENZELLER had only young specimens, for he gives 10 cm. as the size, whereas individuals over 50 cm. long are common in Misaki. As to *H. minax* of THÉEL, I see no reason whatever for separating it from *H. decorata* or from *H. monacaria*. The only point of any importance is that the tables in *H. minax* have only one transverse beam, while in *H. decorata* some of the tables have a larger spire and as many as three beams. When, however, we remember

that MARENZELLER's specimens were young, and similar differences in the shape of tables can be observed in *Stichopus japonicus* according to age (see MITSUKURI 1897*a*), I think the single point just mentioned hardly justifies the establishment of a distinct species.

I should like to point out one fact which is of some interest. Among the holothurians of the "Siboga"-Expedition, SLUITER discovered a specimen of *H. monacaria* dredged from a depth of 275 meters. Among specimens of the same species from the Sagami Sea there are four from a depth of 110 fathoms or about 220 meters, while many specimens are daily obtained by fishermen from a depth of only 25 fathoms or even less so that the vertical distribution of the species appears to range down to a moderately great depth. It is somewhat strange that no specimens have been reported either from Liu-Kiu or Formosa, but this may be due simply to insufficient exploration.

The dorsum is distinctly divided from the ventrum. The former is provided with papillæ, the latter with pedicels. On the dorsum exist also large tubercles which, though low when contracted, in the fully extended state are of a conical shape and terminate in papillæ. The tubercles are in six rows: one at the edge of the dorsum on each side, and two on each of the dorsal radii. On the latter the tubercles are set alternately in the two rows. There are about 17—20 tubercles in each row. They may be about 1 cm. in diameter at base, and 7—8 mm. high when extended. All papillæ end bluntly, so that they probably contain end-plates.

On the ventrum there is often, but not always, a median line devoid of pedicels. There may be present, with or without this median clear space, two lateral clear spaces which divide the

pedicels into three zones if the median line is absent, or into four zones if this is present. In the latter case, each zone consists of about four rows of pedicels; in the former case, the median zone of pedicels is the broadest of the three, having 7—10 pedicels across. In certain specimens the pedicels are apparently scattered all over the ventrum without any of the clear lines just mentioned. It is more than probable that the division of the pedicels into zones by the clear lines is most conspicuous in the younger specimens.

Color of ventrum always lighter than that of dorsum,—either almost white or tinged with a light straw yellow. The bases of pedicels are surrounded by a dark brown, the basal parts of each pedicel being also similarly colored. Beyond this, the tip of the pedicel is yellow. The ground color of the dorsum is generally a very light brown. There is a difference in shade in different individuals, those from the deeper waters seeming to be generally darker. In one specimen, there was a slight greenish yellow tinge to the ground color. Numerous dark brown spots mark the bases of dorsal papillæ. Although these spots are generally scattered without any order, those on the line, or just outside the line, of the inner series of tubercles on each dorsal radius are often arranged more or less in a longitudinal line; and furthermore as the outer aspect generally, or sometimes all of the adjacent large tubercles, are colored with more or less conspicuous large brown patches, this line stands out prominently; and when the general view of the animal is taken from a distance, it looks like a streak of dark brown on each side of the body. This effect is heightened in most specimens by the presence, just outside the line, of a more or less clear longitudinal streak which is devoid of brown spots (this streak corresponds to the line of the

radius). Outside this again, brown spots at bases of papillæ may be more or less in a line, marking the outer boundary of the clear space; but this seems never so regular as the line first referred to. All the tubercles, excepting those referred to above, are of the light ground color, and, as they are devoid of brown spots, look like whitish patches on the general brown surface of the dorsum. When fully expanded, it is seen that the tip of the cone as well as the base of the surmounting papilla is colored dark brown. All the papillæ have their rather bluntly ending tip tinged slightly yellow.

The cloaca is surrounded by a circle of small papillæ, and the mouth by an oral membrane fringed with papillæ.

Tables among calcareous deposits sometimes with regular (Marenzeller Fig. 12, A) and sometimes with irregular or incomplete base (l.c., Fig. 12, B). Spire with one cross-beam. Crown with 13—20 teeth. Ventral tables plumper than dorsal. Buttons mostly with three pairs of holes, but sometimes with 4—7 pairs. They are often irregular, being deficient in parts or having more holes on one side than on the other.

The species lives under ledges of rock. They are found in all depths from the shore to 25—125 fathoms. It is not cured to any extent into trepangs, nor is it eaten.

Locality:—Querimba (Semper '69); Zanzibar (Selenka '67); Baui (Lampert '96); Insel Bueni (Lampert '96); Kokotoni, Zanzibar (Ludwig '99); Mauritius (Haacke '80, Ludwig '83, Théel '86); Mahé, Seychelles (Ludwig '99); Ceylon (Ludwig '87); Tuticorin (Bell '88); Bay of Bengal (Bell '88); Andaman Is. (Bell '87); Gulf of Manaar (Thurston '90); Nicobar Is. (Semper '67—8); Pulo Tikul (Semper '67—8); Pulo Edam (Ludwig '88); Noordwachter Eiland (Ludwig '88); Batavia (Sluiter '87, '95); Sunda Is. (Koehler '95); Lumu-Lumu, Borneo Bank (Sluiter: 01);

Bai von Kwandang, Pajunga I. (Sluiter: 01); Bai von Pidjot, Lombok (Sluiter: 01); Seba (Savu) (Sluiter: 01); Rumah Lusi, Tiur I. (Sluiter: 01); Laiwui, Obi Major (Sluiter: 01); Haingsisi (Sluiter: 01); Dongala (Sluiter: 01); Kur (Sluiter: 01); Noimini, Timor (Sluiter: 01); Süd Insel (Sluiter: 01); "Siboga" Stat. 105 (Sluiter: 01); Amboina (Semper '67—8, Ludwig '88, Sluiter '94, Koehler '95): Zamboanga, Philippine (Semper '67—8); Celebes (Ludwig '82); Waigui (Ludwig '82); Enoshima (v. Marenzeller '81); Japan (Théel '86); Australia (Selenka '67); King George's Sound (Lampert '85); Thursday Is. (Sluiter '94); Pelew Is. (Théel '86); New Ireland (Quoy et Gaimard '33); Vanikoro (Quoy et Gaimard '33); Loyalty Is. (Bedford '99); Lifu, Loyalty Is. (Bedford '99); Fiji (Théel '86); Rotuma (Bedford '99); Lefeska, Tonga (Lampert '89); Samoa Is. (Semper '67—8); Sandwich Is. (Selenka '67); Tahiti (Lesson '30); Borabora (Lesson '30); Insel Floriana, Galapagos Is. (Ludwig '87).

29. *Holothuria pardalis* Selenka.

(Textfig. 22).

Holothuria pardalis Selenka 1867, pp. 336—7, Taf. XIX., Fig. 85.—Semper 1867—'68, pp. 87, 248, 278, Taf. XXX., Fig. 31.—Semper 1869. p. 120.—Ludwig 1880, p. 7.—Ludwig 1882, p. 137.—Ludwig 1883, p. 169.—Bell 1884, pp. 509, 511.—Lampert 1885, p. 62, Fig. 28.—Théel 1886*a*, pp. 224—5.—Sluiter 1887, p. 192.—Ludwig 1887*a*, p. 3.—Ludwig 1887*b*, pp. 1226—7, 1242.—Ludwig 1888, p. 807.—Bell 1888, p. 389.—Ludwig 1889—'92, p. 330.—Herouard 1893, p. 134, Pl. II., Fig. B.—Sluiter 1894, p. 104.—Ludwig 1894*a*, p. 7.—Sluiter 1895, p. 79.—Koehler 1895*c*, p. 381.—Koehler 1895*d* p. 283.—Mitsukuri 1896, p. 407.—Whitelegge 1897, p. 161.—Lampert 1896, p. 52.—Ludwig 1898*a*, p. 5.—Ludwig 1899, p. 559.—Bedford 1899*a*, p. 839.—Sluiter 1901*b*, p. 12.

Holothuria lineata Ludwig 1874, p. 27, Fig. 42.—Ludwig 1880, p. 7.—Ludwig 1882, p. 136.—Ludwig 1883, p. 170.—Bell 1884, p. 152.—Lampert 1885, p. 63, Fig. 26.—Théel 1886*a*, pp. 225.—Bell 1887*a*, p. 140.

Holothuria peregrina Ludwig 1874, p. 29, Fig. 30.—Bell 1884, p. 152.

—Lampert 1885, p. 63.—Théel 1886*a*, pp, 225.

Holothuria insignis Ludwig 1874, p. 30, Fig. 28.—Ludwig 1880, p. 7. —Ludwig 1882, p. 170.—Lampert 1885, p. 61.—Théel 1886*a*, p. 226.—Bell 1886, p. 28.

Labidodemas punctatum Haacke 1880, p. 47.

Holothuria pardalis var. *insignis* Sluiter 1889, p. 106.—Bedford 1899*b*, p. 145.

Specimens examined :—

Sci. Coll., Spec. No.	No. of individuals	Preservation	Locality	Collector	Date
1224	2	Alc.	Kanze Shoal, Kagoshima harbor.	Mitsukuri & Hara	Mar. 30, '96.
1225	2	„	Natsui, Hyūga, Kyūshū.	„	Apr. 13, '96.
1226	1	„	Kagoshima Prefecture	„	
1227	1	„	Mizoë, Ariake Bay, Hyūga, Kyūshū.	„	Apr. 2, '96.
1223	2	„	Susaki, Chichijima, Ogasawara Is.	Hirota & Sekiguchi	Mar. 27, '94.
1195	6	„	Sakibaru, Naha, Liu-Kiu.	Mitsukuri & Ikeda	Apr. 7, :01.
1194	1	„	Tosa		
1229	2	„	Okaha Reef, off Itoman, Okinawa.	Mitsukuri & Ikeda	Apr. 11, :01.
1233	1	„	Inanze Shoal, Naha, Okinawa.	„	Apr. 18, :01.
	1	„	Makemo I., Paumotu.	Agassiz	Oct. 20, '99.
1272	Several	„	Naha, Okinawa.	Miyajima	May 25, :00.
1283	1	„	Enoshima, Ōsumi, Kyūshū.	Mitsukuri & Hara	Mar. 31, '96.
1281	1	Dried	Liu-Kiu		

Description :—Size :—8 cm. long (Selenka for *H. pardalis*).

"Die grössten derselben sind 6 Cm. lang und an der Körpermitte $1\frac{1}{2}$ Cm. dick" (LUDWIG for *H. lineata*). 9 cm. long (LUDWIG for *H. peregrina*). $4\frac{1}{2}$ cm. long, $2\frac{1}{2}$ cm. broad (LUWIG for *H. insignis*). Up to 8 cm. long (SELENKA for *H. subditiva*), etc.

Shape:—"Nach vorn und hinten ist die Körpergestalt verjüngt" (LUDWIG, *H. lineata*). "Das eine 9 Cm. lange Exemplar verjüngt seine Gestalt nach vorn und hinten ziemlich gleichmässig und ist in der Körpermitte ungefähr 4 Cm. dick" (LUDWIG, *H. peregrina*). "Körper schlank" (SELENKA, *H. subditiva*). Color:—"Schmutzig gelbgrau, auf dem Rücken zwei Reihen von je 5—8 alternirenden schwarzen Flecken. Bisweilen laufen über den Körper auch fünf dunkle Längsstreifen, entsprechend den fünf Längsmuskeln. Eine feine dunkle Punctirung ist über den ganzen Körper ausgestreut. Die Endscheiben hellgelb" (SELENKA, *H. pardalis*). "Die Thiere sind auf grünlich gelbem Grunde fein bräunlich gesprenkelt. Die Radien sind auf der äusseren Haut durch eine feine dunkle Längslinie markirt. Auf dem Rücken ausserdem noch eine Doppelreihe unregelmässiger brauner Flecken" (LUDWIG, *H. lineata*). "Es ist schmutzig-weiss in seiner Grundfarbe und hellbraun gesprenkelt; auf dem Rücken stehen zwei Längsreihen von 8—10 verwachsenen braunen Flecken. Die Füsschen sind an der Spitze von einem feinen, aber deutlich sichtbaren braunen Ringe umgeben" (LUDWIG, *H. peregrina*). "Die Farbe der beiden, $4\frac{1}{2}$ Cm. langen, $2\frac{1}{2}$ Cm. dicken Exemplare ist grau mit einem Stich ins Violette mit dunklen, violettschwarzen, verwachsenen Flecken, welche namentlich auf dem Rücken zahlreich sind und an dem Vorderende und Hinterende des Körpers mit einander verschmelzen" (LUDWIG, *H. insignis*). "Gelbbraun, auf dem Rücken 2 Reihen von je 5—8 alternirenden dunklen Flecken" (SELENKA, *H, subditiva*).

Ambulacral Appendages :—" Die einfachen Saugfüsschen über den ganzen Körper gleichmässig reich vertheilt; nur in der unmittelbaren Nähe des Afters zeigt sich die Tendenz einer Ordnung der Füsschen in fünf Längsreihen " (Selenka, *H. pardalis*). " The dorsal ambulacral appendages have a slightly conical form....the small scattered dorsal appendages resemble papillæ " (Théel). " Die Füsschen des Bauches sind unbedeutend zahlreicher als diejenigen des Rückens und haben grössere Endscheiben als die Rückenfüsschen. Um den runden After steht ein dichter Kranz von winzigen Papillen " (Ludwig, *H. lineata*). " Die Füsschen sind klein und über den ganzen Körper unregelmässig zerstreut. .....Der After ist von einem fünfstrahligen Papillenkranze umstellt " (Ludwig, *H. peregrina*.). " Die gleichartigen zahlreichen Füsschen sind über den ganzen Körper zerstreut " (Ludwig, *H. insignis*). " Die einfachen Saugfüsschen über den ganzen Körper gleichmässig reich vertheilt; doch erkennt man in der Nähe von Mund und After die Tendenz einer Anordnung der Füsschen in fünf Längsfelder " (Selenka, *H. subditiva*).

Calcareous Bodies :—" Die thurmförmigen Hautkörper ähneln denen von *H. princeps*; sie stehen auf einer 0,08 Mm. grossen dornigen Basis und sind 0,035 Mm. hoch. Die schnallenförmigen Gebilde 0,06 Mm. lang, in der Bindefaserschichte zu 0,15 Mm. grossen Kreisen und Ringen zusammengebettet. Die Wandungen der Rückenfüsschen von glatten, rippenartig gekrümmten Kalkstäben gestützt; die der Bauchfüsschen von breiten durchlöcherten, bilateral symmetrischen Platten " (Selenka, *H. pardalis*). " Unter den Kalkkörpern sind die Schnallen unregelmässig entwickelt, meist verkrümmt und verbogen. Die Stühlchen haben eine dornige Basis und einen ganz ungemein kurzen, in meist acht Dornen auslaufenden Stiel. In den Füsschen des Bauches liegen

nahe dem Endscheibchen gegitterte Stützplättchen, in den Rückenfüsschen nur an den Enden durchbrochene Stützstäbchen" (Ludwig, *H. lineata*). "Von Kalkkörpern finden sich Schnallen, welche plump unregelmässig durchlöchert sind, ferner Stühlchen, welche halb so hoch als breit sind, eine gedornte Scheibe und einen in der Regel achtspitzigen Stiel haben. Die Stützstäbe haben eine langgestreckte Schnallenform." "In ihrer (Füsschen) Wandung liegen glatte, gebogene und nur an den Enden durchbrochene Stützstäbchen. Nahe den Endscheiben der Füsschen werden die schnallenförmigen Kalkkörper länger als in der übrigen Haut" (Ludwig, *H. peregrina*). "Von Kalkkörperchen finden sich Stützstäbchen, Stühlchen und Schnallen; letztere sind unregelmässig und meist nur halbseitig entwickelt" (Ludwig, *H. insignis.*). "Die thurmförmigen Kalkkörper der Pigmentschicht gleichen denen von *H. pardalis*. Die glatten schnallenförmigen Gebilde der Bindefaserschicht sind 0,040,06 Mm. lang, in den Füsswandungen ein wenig grösser" (Selenka, *H. subditiva*). "Buttons not collected into groups or circles" (Théel).

Tentacles :—"Die 20 Tentakel sind gelblichweiss und sehr klein, dem entsprechend haben auch die Tentakelampullen eine geringe Grösse" (Ludwig, *H. lineata*). "20 gelbe Tentakel, deren Scheibe in verästelte Fiederchen zerfällt" (Ludwig, *H. peregrina*). "Die 20 gelben, 8—10 Mm. langen Tentakel haben eine Scheibe, welche in verästelte Fiederchen zerfällt" (Ludwig, *H. insignis*). "Tentakel 20" (Lampert, *H. pardalis*). "Tentakel klein" (Sluiter). "Tentakel 20" (Lampert, *H. subditiva*).

Calcareous Ring, Polian Vesicles, Stone-Canals, Cuvier's Organs etc. :—"2—4 Poli' sche Blasen, sehr kleiner Steinkanal" (Lampert, *H. pardalis*). "Cuvier'sche Organe fehlen ganz" (Sluiter). "Der Kalkring ist nur 2 mm. hoch. Die.... Geschlechtsschläuche

.....inseriren etwas hinter der Körpermitte. Cuvier'sche Organe fehlen" (Ludwig). "Der Kalkring ist ungemein klein; die Radialia sind nur 1½ Mm. hoch. Eine 8 Mm. lange Poli'sche Blase und ein dorsal festgelegter 2 Mm. langer Steinkanal sind vorhanden. .....Cuvier'sche Organe fehlen an den geöffneten Individuen" (Ludwig, *H. lineata*). "Der eine dorsale, 1 Cm. lange Steinkanal hängt frei vom Wassergefässring herab, Poli'sche Blasen sind zwei vorhanden, deren grössere 2 Cm. lang ist. Die Geschlechtsorgane inseriren 1/3 vom Vorderende des Thieres" (Ludwig, *H. peregrina*). "Die Körperhaut ist dick, die Muskulatur sehr stark entwickelt.....Die Radialia des Kalkringes sind stark 2 Mm. gross, die Interradialia etwas kleiner. 2 Poli'sche Blasen von je 3 Cm. Länge sind vorhanden, ferner 2 Steinkanäle, von denen der eine im dorsalen Mesenterium festliegt, der andere frei in die Leibeshöhle herabhängt" (Ludwig, *H. insignis*). "Die wenigen mir vorliegenden bis 8 Cm. langen Exemplare unterscheiden sich nur durch die mehr oder weniger deutliche Fleckung. Die Tentakelscheiben sehr klein, kaum über 1 Mm. breit. Der Kalkring wie in *Stichopus Kefersteinii* gebildet. Lunge und Blutgefässe mit vielem eingestreuten Pigment; Cuvier'sche Organe blinddarmförmig, zu Büscheln zusammengruppirt. Ringkanal dünn, sehr tief (1—2 Cm. unterhalb des Kalkringes); Poli'sche Blasen 2—4; Steinkanal sehr winzig; Tentakelampullen ganz kurz" (Selenka, *H. subditiva*).

Remarks:—The specimens I have examined come from the southern part of Japan proper (Satsuma, Hyūga, Ōsumi and Tosa) and from Liu-Kiu and Ogasawara Islands. Those which I collected myself in the Liu-Kius were all found on dead coral reefs.

The largest among them is 8 cm. by 2 cm. (No. 1225); the smallest 2.7 cm. by 0.9 cm. (No. 1195). There are all sizes

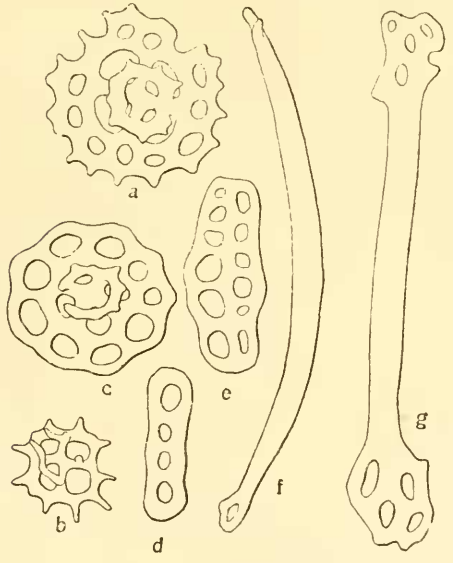
between these.

The color is brown in many shades: some being decidedly dark, while one from Paumotu is so light that it may be described as white speckled with brown. The specimens from the Okaha Reef (No. 1229) have a decided yellow tinge. The state and differences of preservation have, no doubt, had a great share in producing the different appearance of different specimens. By far the largest number show on the dorsum two series of dark brown spots 7—8 in number, each series corresponding to each of the two dorsal ambulacra. The specimens from the Okaha Reef have no dark spots but only small brown dots scattered all over the body. The Paumotu specimen has a few dark spots and in addition has minute brown scattered dots. In some, the bases of the pedicels appear as small light specks (Nos. 1195, 1229, 1223 and the Paumotu specimen). In some, the ventrum is lighter than the dorsum, while in others, no difference is discoverable between the two surfaces, except for the brown spots already referred to, and where those spots are absent, no coloration distinguishes the two surfaces. In all the specimens, the groups of buttons are visible as minute dots to the naked eye or at least under a hand-lens. In some, shallow grooves are marked on the outside along the five ambulacra.

In some specimens, pedicels are more numerous on the ventrum than on the dorsum (Nos. 1224, 1225). In others, pedicels seem uniformly scattered all over the body (Nos. 1194, 1195, 1223, 1227, 1229 and the Paumotu specimen): In all, the pedicels seem to be more or less in longitudinal rows along the five ambulacra. In some individuals the ventral median ambulacrum has four rows of pedicels, while the two lateral have two rows each. On the dorsum they are more scattered, but still the rows on the

two ambulacra are recognizable (Nos. 1223, 1225). In some (No. 1227) the body is cylindrical and the pedicels are arranged in five ambulacral zones, especially obvious near the anus. In all, dorsal appendages seem to have the end-plates more weakly developed than in the ventral pedicels; still in some they are tolerably well developed, while in others they are very small; in fact, it is very difficult to make a clear distinction between pedicels and papillæ.

Calcareous deposits are tables and buttons. Buttons in groups which are visible to the naked eye or at least under a hand lens. In one specimen, the groups measured in diameter 0.17, 0.24, 0.32, 0.40 mm. In the Ogasawara specimen (the larger one of No. 1223), the groups are in the shape of rings. In some (No. 1224,) these are covered over with tables so that at first sight they appear more like groups of tables than of buttons, while in others they are obvious from the outside. The buttons are either (i) complete and then mostly provided with three pairs of openings (textfig. 22 *e*) or (ii) half-sided (*d*). Occasionally (iii) there are some which are reduced to the central rod only with bent ends, so that a short thick C-shape may be produced (Nos. 1229, 1133). There are all sorts of intermediate forms



Textfig. 22.

Holothuria pardalis: *a*, *b*.—Tables with spiny margin; *c*—table with smooth margin; *d*—half-sided button; *e*—ordinary button; *f*, *g*—supporting rods seen from different sides. (×300).

between those mentioned above. They may all be mixed together in one individual; but there is a tendency for some one type to be predominant in one individual. Buttons and tables are more or less scattered in the interspace between the groups.

Tables have generally a spiny margin. In some, only the four central holes with the spiny margin are present in the disk (*b*). Very frequently a more or less complete second circle of holes is present: this is probably the commonest form (*a*). In one specimen (No. 1227) tables are plump, and may have a third circle of small holes in addition. Disks with smooth margin are occasionally seen (*c*). The spire may be rudimentary, but oftenest has one cross-beam and ends in a crown which has 7—12 teeth. The small Tosa specimen (No. 1194), measuring 2.7×1.2 cm., has very peculiar calcareous deposits and is referred to this species with considerable doubt. In it tables with spinous margin are rare; by far the largest number of them have smooth crenate margins and a second circle of holes, their sizes varying considerably. Occasionally among them, large tables (0.12 mm.) are found, with four very large central holes and some smaller ones added. These large tables seem to have a tall spire, probably with two cross-beams. Buttons in the specimen are half-sided. In other characters, it approaches the other specimens of *H. pardalis*. Considering its small size, it is probable that we have here to do with a young individual of the species. As already mentioned, tables with smooth margin are found in other individuals too, but not proportionally so numerously in relation to spiny-margined ones as in the small specimen under question. Since, now, the spiny margin is simply an expression of an incomplete formation or of the degeneration of the table-disks, it seems possible that

H. pardalis, when young, has smooth-margined tables as in the young of *Stichopus japonicus*, and that the large tables occasionally found are remnants from still earlier stages in which the tables were generally of that size and had a tall spire with two or more cross-beams.

In the species, supporting rods are present in ambulacral appendages in the shape of bent rods having the ends slightly enlarged and perforated (*f*, *g*).

Polian vesicle mostly one, in one specimen two (No. 1225); quite long, being about 3.5 cm. long in a specimen of 8 × 2 cm. Stone-canal dorsal, small, single and free, ending in an oblong end. A diligent search failed to reveal a second attached stone-canal. In every specimen which I searched for Cuvierian organs, there was a bundle of very short tubes at the bifurcation of the respiratory tree. In an individual of 3 × 2 cm., the bundle formed a yellowish oval mass 4 mm. in length and 3 mm. in width, and consisted of a large number of minute tubes 0.08 mm. in diameter and 2 mm. in length. This undoubtedly represents the Cuvierian organ and agrees well with Selenka's description of the same in *H. subditiva*.

Calcareous ring very narrow; only 1 mm. high in a specimen 8 × 2 cm. Reproductive organs are placed far back: at about the middle of the body or even behind that point.

The examination of these specimens shows that this is a species exhibiting a very wide range of variation in color, in ambulacral appendages, in calcareous deposits, etc. There can not only be no doubt that *H. lineata*, *H. peregrina* and *H. insignis* should be united with *H. pardalis;* but also, the great authority of Ludwig to the contrary notwithstanding, that *H. subditiva* should be included in that species, as Théel, Sluiter and Bedford have

stated. Now that Cuvier's organ is proved to be present in *H. pardalis*, there exists no substantial distinction between it and *H. subditiva*.

Locality:—Sandwich Is. (Selenka '67); Zanzibar (Selenka '67, Lampert '85, Ludwig '87); Mozambique (Semper '67—8); Red Sea (Semper '67—8, '69); Port Mackay (Semper '67—8); Samoa (Semper '67—8, Ludwig '74); Bowen, Australia (Ludwig '74); Nangkauri (Ludwig '83); Mauritius (Ludwig '83); Glorios O I. (Bell '84); Thursday I. (Bell '84, Sluiter '94); Port Philip (Lampert '85); Amboina (Lampert '85); Cebu (Lampert '85); Kosseir (Lampert '85); HongKong (Ludwig '80); Querimba (Lampert '85); Eoon (Théel '86); Palaw Bay, Mergui Archip. (Bell '86); Andaman Is. (Bell '87); Bai von Batavia (Sluiter '87, '95); Honolulu (Ludwig '87); Massaua, Red Sea (Ludwig '87); Ceylon (Ludwig '87); Falkland I., Antarctic Ocean (Ludwig '87); Pulo Edam (Ludwig '88); Noordwachter Eiland (Ludwig '88); Bay of Bengal (Bell '88); Ambon (Sluiter '89, : 01); à la fontanie de Moïse, Red Sea (Herouard '93); "Albatross" Stat 3368 (Ludwig '94); Sunda Is. (Koehler '95); Funafuti (Whitelegge '96, Bedford '99); Bani (Lampert '96); Tumbatu (Lampert '96); Kokoloni, Zanzibar (Ludwig '98); Aldabra I. (Ludwig '98*c*); Mahé, Seychelles (Ludwig '98); New Caledonia (Bedford '99); Roma (Sluiter : 01); Lucipara I. (Sluiter : 01); Kwandang Bay (Sluiter : 01); Sanguisiapo (Sluiter : 01); Beo, Karakelang I. (Sluiter : 01); Pepela Bai, Rotti (Sluiter : 01); Binongka (Sluiter : 01); Southern Japan; Ogasawara Is.; Liu-Kiu Is.

30. *Holothuria pervicax* Selenka.

(Textfig. 23).

Holothuria pervicax Selenka 1867, p. 327, Taf. XVIII, Fig. 54.—Semper 1867—'68, pp. 92, 251, 279.—Semper 1869, p. 120.—Ludwig 1883, pp. 156—7, 173—4.—Lampert 1885, p. 62. Fig. 25.—Théel 1886*a*, p. 213.—Ludwig 1887*a*, p. 32.—Ludwig 1889—'92, p. 330.—Sluiter 1894, p. 104.—Lampert 1896, p. 53.—Ludwig 1899, p. 560.—Sluiter 1901*b*, p. 9.

Holothuria depressa Ludwig 1874, p. 32, Fig. 44.

Holothuria mimiculata Haacke 1880, pp. 46, 48.

Holothuria fusco-cinerea var. *pervicax* Bedford 1899*a*, p. 837, Pl. LII. Figs. 2*a*, *b*.

Specimens examined :—

Sci. Coll., Spec. No.	No. of individuals	Preservation	Locality	Collector	Date
1055	1	Alc.	Aburatsubo, Koajiro, Misaki (shallow water).	Aoki	Nov. 18, '99.
1222	1	„	Misaki		July, '97.
1221	1	„	Shimoda harbor, Izu.		Aug. 13, '99.
1031	1	„	Kagoshima	Mitsukuri & Hara	Apr., '96.
	1	„	Liu-Kiu		
1030	6	„	Futami harbor, Chichijima, Ogasawara Is.	Hirota & Sekiguchi	Apr., '94.
1040	1	„	Hosojima, Hyūga, Kyūshū (shallow water).	Terasaki	Mar., '99.
1240	1	„	Tomari-mura, Naha, Okinawa I.	Ikeda	Apr. 17, : 01.
1277	1	„	Koajiro, Misaki.	Mitsukuri	Apr. 2, : 00.
1280	1	„	Sata-mura, Kagoshima prefecture.	Higashi	

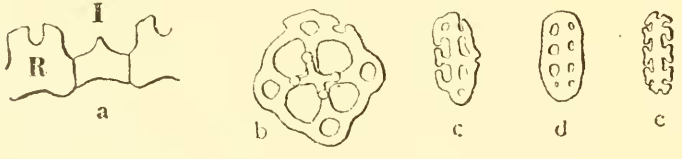
Description :—Tentacles 20, yellow. „Der Bauch ist abgeplattet und deutlich abgesetzt gegen den gewölbten, warzigen Rücken“ (Ludwig 1874, p. 32). „Die Warzenfüsschen des Rückens spärlich, die einfachen Füsschen des Bauchs zahlreich. Der Mund von einem dichten Papillenkranze umgeben“ (Selenka p. 327). „Auf dem Bauche stehen sehr zahlreiche Füsschen, auf dem Rücken finden sich auf warzigen Verdickungen der Haut spärliche Ambulacralpapillen“ (Ludwig p. 32). „Thier hellgraubraun“ (Se-

LENKA p. 327). „Graubraun, auf dem Rücken drei bis vier grosse, quergestellte, braune Flecken. . . . . Die Rückenwarzen sind auf ihrer Höhe dunkel gefärbt; die Füsschen des Bauches hingegen stehen auf heller Basis und haben an den einen Exemplaren eine helle, an den anderen eine dunkelbraune Endscheibe" (LUDWIG p. 32). „Nur das grössere Tier von den Lucipara-Inseln hatte (as an exceptional coloring) den ganzen Rücken dunkelbraun, den Bauch weisslich, die Füsschen dunkel" (SLUITER 1901). Calcareous deposits are tables and rods. The tables are „nur 0,024 Mm. hoch; unter ihnen finden sich zahlreiche kurze Stäbchen mit warziger Oberfläche von 0,024 Mm. Länge. In den Wandungen aller Füsschen liegen, nahe dem Endscheibchen, viele glatte rippenartig gekrümmte Stützstäbchen, in denen der Bauchfüsschen oft noch maschige, bilateral symmetrische Platten" (SELENKA p. 327). „Die schnallenförmigen Kalkkörper haben die. . . . . characteristische Gestalt, die Stühlchen kommen in verschiedenen Formen vor, von den die niedrigeren häufiger sind; in den Füsschen und Papillen liegen lange Stützstäbe, die namentlich in ersteren gegittert sind" (LUDWIG p. 32), "The tables are not very well developed, the spire being often more or less reduced, short, and terminating in four simple teeth; the disks are small, rounded, smooth or slightly uneven on the margin. The small, more or less elongate rods are characterised by being uneven and warted, or distinctly undulated, or deeply incised so as to form a row of loops or holes along each side. . . . . The rods present examples of transitional forms between simple rods and 'buttons.' Pedicels and papillæ with numerous, slightly curved rods provided with spines. These rods have often a complete or incomplete series of holes along one or both sides, or only at the ends. Terminal plates of the papillæ very rudimentary" (THÉEL p. 213).

„Die Kalkkörper zeigen alle Uebergänge zwischen den von Selenka abgebildeten und denjenigen, welche ich früher von der von mir aufgestellten Art *H. depressa* gab" (Ludwig 1883, p. 173). „Die Tentakelscheiben und der Kalkring sind von mittlerer Grösse; die Interradialia des letzteren so breit als die Radialia hoch sind. Tentakelampullen klein. Cuvier'sche Organe braun, blinddarmförmig. Kloake im Innern nicht pigmentirt" (Selenka p. 327). Polian vesicle single, 3 cm. long; the single dorsal stone-canal free in the body-cavity and 1 cm. long.

Remarks:—The distinction between the dorsal and the ventral surfaces is marked in all the specimens. The ventrum is in all crowded with numerous pedicels and is, except in the Ogasawara specimens of an ashen-white color. In the Ogasawara specimens, which are all young, being 4.5—7 cm. long, the coloring of the whole body is considerably darker and the ventrum shares in the deep shading, resembling, I imagine, the Lucipara specimen which Sluiter studied. The dorsum has fewer papillæ, is of a more or less brown color, and differs considerably in coloration in different specimens; but I believe the last fact is due in a large degree to the state of preservation rather than to original differences in the specimens themselves. The specimen from Kagoshima (No. 1031), which is at present 13 cm. long, has the dorsum uniformly light brown with darker brown spots marking the position of the contracted papillæ. There is a suggestion of a median longitudinal darker band of no definite breadth. This seems to correspond best with Selenka's original description. In the specimen from Aburatsubo (No. 1055, at present 12 cm. long, in life 18—20 cm.), of which a rough sketch made from life by my assistant, Mr. Tsuchida, remains, the dorsum has a light brown ground color. On this, a not sharply marked longitudinal median

band, of a considerably darker brown color and of a width about $\frac{1}{3}$ that of the body, runs from the anterior to the posterior end. In this, there are several specially darker transverse areas which, extending laterally outward, appear like large transverse bands. At the outer ends of these bands, or interspersed between these ends, there is on each side of the body an irregular series of seven or eight dark brown spots about 0.5—1 cm. in diameter. A large papilla occupies the center of each of these spots. Other papillæ which are scattered all over the dorsum have also dark bases, and when contracted, appear to divide the dorsal surface into a number of small polygonal areas. In the Shimoda specimen (No. 1221) which is much contracted, these transverse bands are very conspicuous. They seem to agree with SEMPER's description. The Ogasawara specimens (No. 1030) are all much darker, but four or five dark transverse bands can be made out. In the two smallest (4.5 and 5 cm. long) there is a ventral median longitudinal line devoid of pedicels. The specimen from Tomari-mura, Naha, Okinawa (No. 1240, in life 14 cm., now 7.0 × 1.6 cm. in alc.) has now on the dorsum a dirty brown color. On this, there are six much darker transverse bands. The whole dorsum is occupied by larger and smaller mammæ-like elevations, the largest of which are nearly 5 mm. in diameter. These elevations are arranged in pairs in six dark bands; they have each a papilla on top.



Textfig. 23.

Holothuria pervicax: *a*—Calcareous ring; *b*—Table; *c*, *d*—Button-like rods; *e*—Ordinary rod. (*b*—*e* × 400). I—Interradialia; R—Radialia.

The calcareous deposits consist of tables and rods. The former

(textfig. 23*b*) are mostly in the rudimentary condition, i.e., there stand on a disk, which varies very much in the degree of its development, three or four short teeth representing the rudiments of a spire. In some the spire may be developed as far up as the cross-beams, which may however not unite all the four pillars. In the more developed ones, the four pillars grow beyond the cross-beams to varying lengths and each end in a simple top without being united into a crown. I have seen tables which have two stories of cross-beams, and LUDWIG (1874) also figures such. These seem to be more common on pedicels. I have tried to see if perfect tables are not commoner in the young, or if there do not exist tables with several cross-beams in each. So far as the smaller specimens in my possession go, even the youngest of only 4.5 cm. length, seem to have the tables all rudimentary.

The rods are much more numerous than the tables and form a layer inside these. The most numerous form among them is that shown in textfig. 23 *e*. It has enlarged ends and from both its sides there arise several laterally directed branches, which mostly terminate in a small, longitudinally directed piece. The result is that the rods in certain cases assume the form of small buttons (*c*, *d*), there existing sorts of intermediate forms. In the Tomari-mura specimen (No. 1240) the buttons in shape approach nearest to SELENKA's figures, i.e., they are rods with irregular protuberances on each side.

Ventral pedicels are very numerous; they show a black band near the tip and have well-developed end-plates. In their wall there are present, besides the same calcareous bodies found in other parts, large supporting rods 0.10—0.15 mm. in length and with a latticework developed on each side. Dorsal papillæ are much more sparsely scattered and more slender. So far as I can make

out from somewhat contracted specimens, they are devoid of end-plates. The supporting rods are simple curved rods of about the same length as those in ventral pedicels, but with, at most, short tooth-like projections at irregular intervals along the sides instead of latticework.

In one small specimen (No. 1030), I observed one rather large stone-canal on the right side near the dorsal mesentery, and three finger-like Cuvierian vesicles on the left respiratory tree near its base. No Polian vesicle could be detected. In a large specimen (No. 1040) I found one stone-canal 1 cm. long near the dorsal mesentery on the right side and one Polian vesicle several cm. long on the left ventral interambulacrum; a bunch of numerous large Cuvierian threads, 2 mm. thick and up to 9 cm. long, was present on the respiratory tree before its bifurcation, a few more threads occurring also on the right respiratory tree.

The calcareous ring of the species is of the structure shown in textfig. 23*a*.

As to BEDFORD's statement that this species ought to be merged with *H. fuscocinerea* JAEGER and with *H. curiosa* LUDWIG, I am strongly inclined to accept it. The specimens which I have examined may without much difficulty be placed in *H. fuscocinerea*. In nearly all of them, many of the rods become converted into buttons, although I can not find any exactly corresponding to those figured by SEMPER for *H. fuscocinerea*. In other points, the specimens may be said to agree completely with the description of *H. fuscocinerea* by that author. Further, the fact that, although *H. fuscocinerea* has been reported by LUDWIG to occur in Japan, I have not as yet come across any specimens that I can indubitably identify with it, may be said to speak for the identi-

ty of that species with *H. pervicax*. I deem it not unlikely that some of the specimens I have placed in *H. pervicax* might be referable to *H. fuscocinerea*. It would be helpful if those who have specimens of the latter species would carefully re-examine the point in question. The only point in which the two species seem to differ consists in the shape of the buttons, and this can probably be bridged over.

Bedford's statement that *H. argus* Jaeger is a close ally of the present species, I can not support, as the two species are very clearly distinguishable both in calcareous deposits and in coloration. For details see the description of *H. argus* in the present memoir.

Locality:—Red Sea (Semper '67—8); Assab (Ludwig '87); Zanzibar (Selenka '67); Bueni (Lampert '96); Mauritius (Haacke '80, Ludwig '83); Seychelles (Lampert '85); Rotti, Bay of Pepela (Sluiter : 01); Lucipara Is. (Sluiter : 01); Saleyer Is. (Sluiter : 01); Gisser (Sluiter : 01); Kabaëna I. (Sluiter : 01); Amboina (Sluiter '94); Philippine Is. (Ludwig '74); Pelew Is. (Ludwig '74); Australia (Semper '67—8); Samoa, Navigator Is. (Théel '86); Sandwich Is. (Selenka '67); Tahiti (Ludwig '74); Rotuma (Bedford '99); Pacific coasts of Japan; Liu-Kiu Is.

31. *Holothuria scabra* Jaeger.

(Textfig. 24).

Holothuria scabra Jaeger 1833, p. 23.—Brandt 1835, p. 56.—Selenka 1867, p. 341.—Semper 1867—'68, pp. 79, 247, Taf. XIX., Taf. XXXIII., Fig. 15, Taf. XXXIV., Figs. 2, 3, 4.—Selenka 1868, p. 118.—Ludwig 1880, p. 6.—Haacke 1880, p. 46.—Ludwig 1881, p. 599.—Ludwig 1882, p. 135.—Ludwig 1883, p. 168.—Lampert 1885, p. 69.—Théel 1886*a*, p. 234.—Ludwig 1887*a*, p. 31.—Ludwig 1887*b*, pp. 1224, 1242.— Sluiter 1887, p. 193.—Ludwig 1888, p. 807.—Ludwig 1889—'92, p. 330.—Sluiter

1894, p. 103.—Sluiter 1895, p. 78.—Lampert 1896, p. 54.—Ludwig 1899, p. 557 :—Sluiter 1901*b*, p. 11.

Holothuria tigris Selenka 1867, p. 333, Taf. XIX., Figs. 70—72.

Holothuria cadelli Bell 1887*b*, p. 144. Pl. XVI., fig. 7.

Specimens examined :—

Sci. Coll., Spec. No.	No. of individuals	Preservation	Locality	Collector	Date
1177	4	Alc.	Setouchi Strait, Amami-Oshima.	Yoshiwara	
1052	4	„	Liu-Kiu Is.		
1215	1	„	Manjuyod, South Negros, Philippines (Shallow water).	B. Dean	
	1	„	Guam I.	A. Agassiz	Feb. 27, : 00.
1258	2	„	Torres Strait	Nishikawa	
1259	3	„	„	„	
1302	1	Dried	„		
1317	4	„	Liu-Kiu		Apr., : 01.
1388	1	„	„		„
1440	1	„	South Pacific		

Description :—Tentacles 20, white, small. Ambulacral appendages numerous, simple, all papillæ (Théel), at least with small terminal plates. Calcareous deposits :—(i) Tables solid, 0.048 mm. high with a smooth, well-developed disk and a spire of the usual shape terminating in a crown with 12—16 teeth. (ii) Buttons 0.048 mm. long, symmetrical, mostly with three pairs of holes, and knobbed. Color :—Dorsum olive green or olive brown, sometimes with irregular white spots ; ventrum whitish

with numerous fine dark points and a median longitudinal groove. Anus star-shaped. Skin rough. Size up to 28 cm. Polian vesicle one. Stone-canal one, very large, $\frac{1}{4}$—$\frac{1}{2}$ the length of the body, consisting of several meandering hollow stripes. Cuvierian organ in the shape of blind guts, often very numerous (up to 100). Tentacular ampullæ long.

Remarks :—The four large specimens from Ōshima measure in the present contracted state 12—13 cm. in length and 7—8 cm. in breadth; but as their skin is very thick, it is quite conceivable that in the fresh state they would easily attain a length of 30 cm. or more. Their color on the back is dark-grey with a tinge of green, being darkest along the middle of the back. From this, it becomes gradually ashen-grey at the sides and passes into white on the ventral surface. All over the body are scattered dark points which mark the positions of ambulacral appendages. These show themselves very conspicuously on the ventral surface as black spots on the white ground, and are most numerous along the three ambulacral lines. On one of the specimens they are each marked with a small white ring showing best on the dark ground of the dorsum and the sides. The skin is rather smooth and hardly deserves the name *scabra*. Ambulacral appendages are all small. Dorsal papillæ are unfortunately all much contracted : so far as I have examined, I have not been able to make out an end-plate in any of them. Even on the ventral pedicels this is very weakly developed.

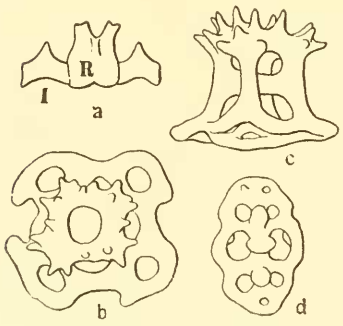
The Guam specimen is 11 cm. long and 5.5 cm. broad. The color is decidedly dark-brown on the dorsum and greenish white on the ventrum. In this specimen I was able to recognize end-plates in both the dorsal papillæ and the ventral pedicels. Those in the latter are decidedly more strongly developed than those in the

ventral pedicels of the large Ōshima specimens above mentioned.

The South Negros specimen is 8 cm. long and 3.5 cm. broad. It is much rougher to the touch than any specimen in the above two sets. In coloring it much resembles the Ōshima specimens. The ventral pedicels have well-developed end-plates. The dorsal papillæ, at least some of them, also have well-developed end-plates.

The Liu-Kiu specimens all measure about 4.5 by 2 cm. The skin, which is thin, is quite rough to the touch. Their color resembles on the whole that of the Ōshima specimens, but is somewhat darker on the dorsum and dirty white on the ventrum. On two of them there is a narrow median longitudinal groove—a structure not distinct in any of the other specimens in their present contracted state. The end-plates are found in both the ventral and the dorsal ambulacral appendages.

The three specimens from Torres Strait (No. 1259) are remarkable in that they are almost black in color on the dorsum and on the ventrum have a tolerably dark shade of yellowish brown. They are like other specimens in every other detail.



Textfig. 24.

Holothuria scabra : *a*—Calcareous ring ; *b*, *c*—Tables of dorsum ; *d* —Button of ventrum. (*b*—*d* × 300). I—Interradialia ; R—Radialia.

Calcareous deposits are very abundant, especially in the ventral perisome. They consist of tables outside, and a bed of buttons inside. It will be seen from the figures (textfig. 24 *b*, *c*) that the tables in these specimens have a rather solid irregularly quadrilateral disk with smooth margin. The disk is frequently irregular and incomplete, in which case the central opening is often eccentric in position. In complete disks

there is a circle of rather small holes around the central opening, but in complete ones this circle is often interrupted. The spire is built of four rods with a transverse beam and terminates in a crown with 12—16 or more teeth. The buttons (*d*) have mostly three pairs of openings with the margin decidedly crenate. There are knobs on the middle beam, and very often other parts are also beset with the same. The calcareous bodies in the ventral perisome are plumper than those in the dorsal, so that the holes are smaller. In the small Liu-Kiu specimens there are, besides the tables of the same shape, some others with much larger disk but comparatively small crown and with two or more circles of small holes around the central opening in the disk. It seems therefore probable that in this species also the young animals have tables that are larger and more complete than those in the old.

The anus appears to be stellate, and is surrounded by five groups of small papillæ. Polian vesicle one. Stone-canal, attached to the right of the dorsal mesentery, very large, long and band-like, having the characteristic appearance described by SELENKA (1867, p. 333, Fig. 71 *x*). Its wall contains felt-like fibres which appear to me to be of an elastic nature and not calcareous. Calcareous ring, as shown in *a* of the textfigure. Even in well-preserved specimens I can not discover any Cuvierian organ, which is probably wanting in this species.

From the foregoing account two interesting facts stand out: 1) the end-plates of both the dorsal and the ventral ambulacral appendages are more developed in the young than in the old individuals, and 2) among the calcareous deposits the tables are larger and more completely built in the young than in the old individuals. From the first of these facts, it is not entirely cor-

rect to describe the ambulacral appendages of this species as all papillæ, as THÉEL does. In the younger individuals the ventral appendages must be described as pedicels.

H. aculeata SEMPER certainly resembles this species very closely, as is stated by THÉEL. I should, however, like to point out one difference not noticed before; viz., that the stone-canal in *H. aculeata* is described by SEMPER as very small, while the same in all the specimens of this species which I have examined is specially long and large. This species seems to approach also *H. notabilis* LUDWIG, *H. klunzingeri* LAMPERT, *H. occidentalis* LUDWIG and *H. sulcata* LUDWIG.

Locality:—Red Sea (SEMPER '67—8); Berbera (LUDWIG '83); Bay of Margalla (LUDWIG '87); Zanzibar (SELENKA '67, SEMPER '68, LUDWIG '87, LAMPERT '85, '96); Mauritius (HAACKE '80, LUDWIG '83, THÉEL '86); Natal (LAMPERT '85, THÉEL '86); Andaman Is. (BELL '87); Ceylon (LUDWIG '87); Singapore (THÉEL '86); Gulf of Siam (THÉEL '86); Indian Archipelago (SLUITER '95); Batavia (SLUITER '87); Java (SELENKA '67, THÉEL '86); Banka (LUDWIG '82); Macassar (LUDWIG '82); Celebes (JAEGER '33, LAMPERT '85); Dongala (SLUITER : 01); Kwandang (SLUITER : 01); Sanana (SLUITER : 01); Kabala dua (SLUITER : 01); Saleyer Is. (SLUITER : 01); Gisser (SLUITER : 01); Pulu Kawassang (SLUITER : 01); Waru-Bai (SLUITER : 01); Timor (LUDWIG '82, SLUITER : 01); Amboina (SELENKA '67, LUDWIG '88, SLUITER '94); Philippine Is. (SEMPER '67—8, LAMPERT '85); Cebu (LAMPERT '85); New Holland (LAMPERT '85); Torres Strait (THÉEL '86); Fiji (SEMPER '67—8, THÉEL '86); Liu-Kiu Is.; Amami-Ōshima.

32. *Holothuria vagabunda* SELENKA.*

Holothuria vagabunda SELENKA 1867, p. 334, Taf. XIX., Fig. 75—76.—

* I do not yet feel quite equal to the heroic task of superseding the well-known and well-established name *vagabunda* by the designation *leucospilota*: for the present I am willing for the sake of priority to follow previous writers on this point.

Semper 1867—'68, pp. 81, 248, Taf. XXI., Taf. XXXI., Fig. 1, Taf. XXXIV., Fig. 15—17, Taf. XXXV., Fig. 9, 10, Taf. XXXVIII., Fig. 5—8.—Semper 1867, p. 120.—Ludwig 1881, pp. 595—6.—Ludwig 1882, p. 135.—Ludwig 1883, p. 169.—Bell 1884, pp. 509—510.—Lampert 1885, p. 71.—Théel 1886*a*, pp. 180, 218, Pl. VII., figs. 10.—Bell 1886, p. 28.—Ludwig 1887*b*, p. 1242.—Bell 1887*b*, p. 140.—Sluiter 1887, p. 189.—Ludwig 1888, p. 807.—Bell 1888, pp. 385, 387, 389.—Lampert 1889, p. 809—810.—Ludwig 1890.—? Thurston 1890.—Ludwig 1889—'92, p. 330.—Kent 1893, p. 5.—Ludwig 1894, p. 8.—Sluiter 1894, p. 103.—Koehler 1895*c*, pp. 383—4.—Koehler 1895*d*, p. 284.—Sluiter 1895, p. 78.—Whitelegge 1896, p. 161.—Ludwig 1898*b*, pp. 448, 450.—Ludwig 1899, p. 558.—Bedford 1899*a*, p. 145, Pl. XVII., figs. 5 *a*,*b*,*c*.—Bedford 1899*b*, p, 842.

Stichopus (*Gymnochirota*) *leucospilota* Brandt 1835, p. 51.

Stichopus leucospilota Selenka 1867 p. 320.—Semper 1867—'68, pp. 74, 275.

Holothuria vagabunda var. Ludwig 1874, pp. 36–7, Fig. 40.

Specimens examined :—

Sci. Coll., Spec. No.	No. of individuals	Preservation	Locality	Collector	Date
1021	Several	Alc.	Kanze bank, Bay of Kagoshima.	Mitsukuri & Hara	Apr. 30, '96.
1035	3	„	Tosa, Shikoku.		
1042	2	„	Naha, Okinawa I.	Kuroiwa	
1043	1	„	Pescadores (Hattan I.), Formosa.	Tadu	Mar. '97.
1049	2	„	Okinawa I.		
1022	2	„	Natsui, Hyūga, Kyūshū.	Mitsukuri & Hara	
1051	3	„	Okinawa I.		Apr. 26, '97.
1182	1	„	Mizoë, Ariake Bay, Hyūga.	Mitsukuri & Hara	Apr. 11, '96.

Sci. Coll., Spec. No.	No. of individuals	Preservation	Locality	Collector	Date
1183	1	Alc.	Tenchi-mura, Koshiki I., West Coast of Satsuma Province.	Miyajima	July 20, '99.
1023	9	,,	Hachijō I., Izu.		
1179	Several	,,	Kōzu I., Izu.	Aoki	May 15, : 00.
1196	1	,,	Nakagusuku Bay, Okinawa I.	Mitsukuri, Ikeda et al.	Apr. 16, : 01.
1201	1	,,	Nō-i-bisé Rock, Nakagusuku Bay, Okinawa I.		,,
1202	Several	,,	Sakibaru, Naha, Okinawa, among tide-pools, coral reefs.	Mitsukuri, Ikeda et al.	Apr. 7, : 01.
1241	1	,,	Morokata, Chichijima, Ogasawara Is.	Hirota & Sekiguchi	Feb.—Apr., 94.
1278	1	,,	Katsuyoshi, Kageroma I., Amami-Oshima.	Mitsukuri, Ikeda et al.	Apr. 1, : 01.
1295	1	,,	Chinenzaki, Okinawa I.	,,	Apr, : 01.
1296	1	,,	Manjuyod, South Negros, Philippines.	B. Dean	Feb., : 01.
Agass. No. 25*f*	1	,,	Rangirva I.	A. Agassiz	Sept. 21, '99.
,, 15	1	,,	Ponapi, Caroline Is.	,,	Feb. 12, : 00.

Description:—Tentacles 20. Ambulacral appendages ("einfache Saugfüsschen") scattered over the entire body, on the sides often much more numerous than on the ventrum or dorsum; only the appendages of the dorsum possess, besides terminal plates, supporting rods which are spinous and tapering toward the ends (Selenka). Dorsal appendages of two kinds, pedicels and papillæ (Théel). Calcareous deposits: tables small, 0.03 mm. high and 0.05 mm. broad. The crown of the spire with 8 (—10) teeth around the nearly circular aperture. The buttons smooth, 0.048 mm. long and half as broad, of the usual shape with six

holes. Color brown; on the ventral side light. Length of body, up to 20 cm. Calcareous ring, as SELENKA's fig. 75. Cuvierian organ brown-red, hanging in two rows at the bottom of the right respiratory tree. Polian vesicle one. Stone-canal free, simple and small. Tentacular ampullæ tolerably long.

Remarks:—As the above list of the specimens examined by myself shows, the range of this species in eastern Asiatic waters extends from the Philippines through Formosa (Hattan I.) and the Liu-Kiu group to Satsuma from which province I have specimens from several localities. Then coming up along the Pacific side of Japan proper, there are specimens from Hyūga, Tosa, and finally quite up north from the Hachijō and Kōzu Is. in the Shichitō group of Izu. The last named island lies at about 34° 20′ N. Lat., and is over 8° north of the most northern locality hitherto reported. Although Kōzu I. is almost within sight of Misaki, the species has not been obtained at the last locality. This is probably due to the fact that both Hachijō and Kōzu are almost in the direct line of the main current of the warm Kuro-Shiwo.

Ambulacral appendages are found all over the body. In all cases in which I have been able to make sure, there is a clear demarcation between the ventral and the dorsal surfaces. The pedicels on the ventrum are much more numerous than those on the dorsum. They lack supporting rods. THÉEL places this species among those whose ventral pedicels are not arranged in longitudinal series. Although this seems to be the case with large and old specimens, it is different with young individuals. In these three longitudinal rows of pedicels are distinctly recognizable. In a specimen 4.5 cm. long from Formosa, the median series possesses four rows of pedicels while the two lateral series consist of two rows each. In another 7.5 cm. long, this arrange-

ment can still be recognized. THÉEL expresses a great deal of uncertainty as to the condition of the dorsal appendage, but finally comes to the conclusion that there are both pedicels and papillae. My conclusions, after examination of a large number of specimens, are as follows : In the dorsum there are no appendages whose end-plates are as large as those of the ventral pedicels. But there seem to be differences in the reduction of the size. Some dorsal appendages have well-formed end-plates, and their ends may have sucking power. Others are more strictly papilla-like, and have very small end-plates. I can not be sure of a single case where a dorsal appendage is absolutely without any end-plate. My conclusions are therefore very much like those of THÉEL.

Calcareous deposits consist of an internal layer of buttons and an external layer of tables. Buttons are smooth and have mostly three pairs of holes. Their margin is not much crenated. The table from an adult individual from Tosa (8 cm. long in alcohol) have disks both smooth and spinous on the margin. The crown is very characteristic with the central circular aperture and eight or more teeth projecting outwards. The spire is formed of four columns with one transverse beam. It has already been noticed by THÉEL in specimens from the Philippines that there are two kinds of tables. He says : "scattered among the common tables with the wide annular apex of the spire provided with eight to ten teeth, others are found with their spire much more tapering towards the apex which becomes very narrow and comparatively inconsiderable" (1886, p. 180). I find that this is on the whole the case with younger individuals. In an individual from Tosa, there are tables that are conspicuous by their larger size but have smaller crowns as observed by THÉEL. As in-

dividuals grow larger, these large tables with small apexes seem to disappear. The crowns become all large, so that often the crown is as large as the disk. As a rule, the disk seems to become more and more rudimentary, while the annular crown seems to grow in diameter, and after a while, it sends out processes which may unite and thus produce holes.

Cuvierian tubes are generally described as reddish brown, and while such seems to be the color in alcoholic specimens, they are pure white in the fresh state or when shot out, as I can testify from my own observations in collecting this species in Kagoshima Bay. Those who have seen the tubes shot out and sticking to everything within reach, entangling all sorts of animals if placed in the same bucket, can hardly doubt, it seems to me, that they are organs of defense. Anyway they must be said to perform that function remarkably well, even though their primary object be something else. In preserved specimens, the tubes are often half out of the cloaca. By dissecting such specimens, at least in one case, I have found that these tubes were attached to the basal part of the left respiratory tree. When shot out, they seem to pass through an opening temporarily made in the cloacal wall, as I have seen in one case, dorsal to the anus. These facts seem to agree well with those observed by MINCHIN in *H. nigra*.

Locality :—Kosseir (LAMPERT '85); Aden (SEMPER '69); Zanzibar (SELENKA '67, LUDWIG '99); Mozambique (SEMPER '67—8); Natal (LAMPERT '85); Port Louis, Mauritius (LAMPERT '89); Darros I. (BELL '84); Seychelles (LAMPERT '85, LUDWIG '99); Tuticorin, Madras (BELL '88); Gulf of Manaar (THURSTON '90); Ceylon (LUDWIG '90); Bay of Bengal (BELL '88); Andaman Is. (BELL '87); Nicobar Is. (LUDWIG '83); Mergui Archipelago (BELL '86); Gulf of Siam (LAMPERT '85); Sunda Is. (SEMPER '67—8, KOEHLER

'95); Java (SELENKA '67, LUDWIG '82); Bay of Batavia (SLUITER '87); Pulo Edam (LUDWIG '88); Amboina (LUDWIG '88, SLUITER '94, KOEHLER '95, SLUITER '95); Philippine Is. (SEMPER '67—8); Samboangan, Philippine Is. (THÉEL '86); Zebu (LAMPERT '85); Hong Kong (LUDWIG '83); Great Barrier Reef (KENT '93); Bowen (LUDWIG '74); Adelaide (LAMPERT '85); Ualan (BRANDT '35); Jaluit (LAMPERT '85); Lifu, Loyalty Is. (BEDFORD '99); Funafuti (WHITELEGGE '96, BEDFORD '99); Fiji (LAMPERT '85, THÉEL '86); MacKean's I. (SEMPER '67—8); Samoa (SEMPER '67—8, LUDWIG '74); Tongatabu, Friendly Is. (THÉEL '86); Sandwich Is. (SELENKA '67); Society Is. (SELENKA '67); Tahiti (LUDWIG '87); Cocos Is. (LUDWIG '94); Peru (LUDWIG '98); Caroline Is.; Pescadores Is.; Liu-Kiu Is.; East coasts of Kiūshū and Shikoku; Shichitō (Seven Islands, Izu).

33. *Holothuria vitiensis* SEMPER.

Holothuria vitiensis SEMPER 1867—'68, pp. 80, 247—8, 277, Taf, XXX., Fig. 12. — LAMPERT 1885, p. 891. — THÉEL 1886*a*, p. 203. — LUDWIG 1889—'92, p. 330.—KENT 1893, pp. 238—9.—SLUITER 1895, p. 78.—KOEHLER 1895*c*, p. 382.—SLUITER 1901*b*, p. 13.

Specimen examined :—One large alcoholic specimen from Sokari, Amami-Ōshima, collected by Mitsukuri, Ikeda et al. Mar. 30, 1901.

Description :—" 20 Tentakel. Zahlreiche Füsschen auf Rücken und Bauch gleichmässig dicht stehend. Rücken wie Bauch hellbraun, Basis der Füsschen dunkelbraun, die Füsschen selbst heller. Am Wassergefässring eine grosse runde langgestielte Polische Blase, ein einziger dorsal angehefteter Steincanal mit freiem Madreporenknöpfchen. Geschlechtsfollikel sehr zahlreich,..... ihre Basis links vom Mesenterium etwa 2 Cm. vom Wassergefässringe. An der Vereinigungsstelle der Lungenäste mit der Cloake sitzen die längsten und die dicksten CUVIER'schen Schläuche, bis zu 4 Cm. lange; dünnere und kürzere, aber immer einfache sitzen

bis an die äussersten Enden der feinsten Lungenästchen hinauf. Die Kalkkörper ähnlich denen von *H. argus* JAEGER." (SEMPER, p. 80).

Remarks :—The specimen which I examined during life had the following coloration. On the dorsum, a very broad longitudinal band of light straw yellow extended from the anterior to the posterior end, surrounding the large circular cloacal opening, so that the largest part of the dorsum was of that color. Toward the sides the yellow gradually shaded into white, which was the color of the ventrum. Within the yellow band of the dorsum, the dorsal ambulacral appendages had each a brown ring around its base. The appendages themselves were clear and transparent. The brown circles were confined within the yellow area. Toward the sides, the brown changed to yellow. More laterally and on the ventrum, there was no pigment around the ambulacral appendages. In alcohol, the yellow color has faded : the whole animal is of a light brown, somewhat but not much darker in the place where the yellow was present in life. The brown rings around the dorsal papillæ are still somewhat visible.

There is no sharp distinction between the dorsum and the ventrum. It has been said there are papillæ on the former and pedicels on the latter. Microscopic examination shows that some dorsal ambulacral appendages have hardly any or only very small end-plates while others have well-developed end-plates. In life I have noted that there is a band without pedicels on the median ventral line ; but this is not now apparent, as the specimen is contracted in alcohol. The anus is circular, surrounded by five groups of small papillæ. The internal cloacal wall is dark colored.

The calcareous deposits are rosettes resembling those of *H. argus*, *H. marmorata*, etc. In the present specimen, those of the

ventrum are generally oval grains with a mixture of the rosettes and biscuit-shaped grains, all of them being plumper than those of the dorsum. In the ambulacral appendages, there are spicules that are somewhat larger and irregular; some are X-shaped or even rod-shaped with two ends bifurcated, but none that may properly be called supporting rods.

Calcareous ring as in *H. argus*, etc. Polian vesicle one, spherical, with not very long stalk. The stone-canal is attached to the dorsal mesentery and runs forward, its somewhat large madreporic body lying free in that window-like opening which in this and allied species is found between the calcareous ring and the mesentery. Cuvierian tubes abundant. They are found not only on the two respiratory trees but also on branches arising from the common part of these, which part is somewhat longer than in other species. Of the said branches one is especially long. The largest mass of the tubes was found on the left respiratory tree. The genital bundle about 1 cm. behind the circular canal.

A specimen of *Fierasfer* was discovered in the body cavity during dissection, with the head in the cloacal cavity and the tail pointed anteriorly.

This species is one of the group in which are placed *H. marmorata* JAEGER, *H. argus* JAEGER, *H. bivittata*, sp. n., etc. That it bears closest resemblance to these, there can be no doubt, though the coloration in life is so utterly different. The natives of Ōshima distinguish it by a different name "Shiro-Shikiri." Anatomically the species differs from the others mentioned in several details: absence of large supporting rods in the pedicels, the free madreporic body of the attached stone-canal, spherical Polian vesicle, and the arrangement of Cuvierian tubes. So that, I am strongly inclined to maintain the distinctness of this species, although it

is a mere matter of opinion whether a specific or varietal value is to be assigned to each of the forms within the group. There can be hardly any doubt that *H. tenuissima* SEMPER is a synonym of this species.

Locality:—Nicobar (SEMPER '67—8); Fiji (SEMPER '67—8); Samoa (SEMPER '67—8); Sunda Is. (KOEHLER '95); Java (SLUITER '95); Moluccas (SLUITER '95) Lumu-Lumu (SLUITER : 01); Gisser (SLUITER : 01); Amami-Ōshima, S. of Kiūshū.

Holothuria clemens LUDWIG ?

I have a specimen (Sp. No. 1231) taken in shallow water at Manjuyod, South Negros, Philippine Is., by Dr. B. DEAN and kindly given me by him, which belongs in this group of species. It is now much contracted, being 6×4.5 cm., but in life must have been 12 cm. or more in length. Its ground color is white, this being the color of the whole ventrum. On the dorsum, however, the middle is occupied by several large dark brown patches more or less confluent, and also on each side there are four smaller patches of the same color. The specimen being eviscerated, I can not make out the genital organs. It has one long Polian vesicle and one stone-canal which is attached to the mesentery including the madreporic plate. Cuvier's organ can not be well made out although the respiratory trees remain. The calcareous deposits are the usual delicate rosettes in the dorsal perisome and plumper biscuit-shaped or incomplete rosettes with the oval bodies as the most abundant element. Ambulacral appendages irregularly but uniformly scattered over the body. Dorsal appendages have only very small end-plates, and have delicate, slender, rod-shaped supporting rods with somewhat bifurcated ends. Anus with five groups of small papillæ. Calcareous ring as usual in the group.

As the species of this group are marked mostly by external

markings, I have looked for a known species with such coloration as described above. *H. köllikeri* SEMPER and *H. clemens* LUDWIG seem to answer the description best. But in what respects these two species differ from each other and from other species, can not be made out from the works of the authors. Seeing that they come from the same locality—Samoa Islands—it is not impossible that the two are identical. I call my specimen provisionally *H. clemens*, as the stone-canal does not agree with the description of that of *H. köllikeri*.

Genus **Stichopus** BRANDT 1835.

34. *Stichopus ananas* (JAEGER).

(Pl. I., figs. 6—8; textfig. 25).

Trepang ananas JAEGER 1833, p. 24, Taf. III., Fig. 1.

Holothuria ananas QUOY et GAIMARD 1833, pp. 110—116, Taf. VI., Fig. 1—3.—SELENKA 1867, p. 322.

Holothuria ananas (Subgen. *Theronota*, Sect. *Camarosoma*) BRANDT 1835, p. 53.

Holothuria grandis (Subgen. *Theronota*, Sect. *Platysoma*) BRANDT 1835, p. 53—54.

Holothuria grandis SELENKA 1867, p. 332.—SEMPER 1867—'68, pp. 93, 279.

Stichopus ananas SEMPER 1867—'68, pp. 75, 275.—LUDWIG 1881, p. 591.—LUDWIG 1882, p. 133.—LAMPERT 1885, p. 104.—THÉEL 1886*a*, p. 196.—LUDWIG 1889—'92, p. 331.—SLUITER 1901*b*, p. 30, Taf. II., Fig. 1.

Stichopus variegatus KENT 1893, p. 234, Pl. XXXV., Fig. B.

Specimens examined :—

Sci. Coll., Spec. No.	No. of individuals	Preservation	Locality	Collector	Date
1321—1322	2	Alc.	Kiamuzaki, Okinawa I., 30 *hiro*	Mitsukui, Ikeda et al.	Apr. 11, : 01.
1320	1	,,	Jizaka-Reef, Naha, Okinawa.	,,	Apr. 17, : 01.
1223—1224	2	Cured	Okinawa I.		
1012	1	,,	,,		
1138	2	,,	,,		

Description :—Tentacles 20. Ventrum flat with numerous ordinary pedicels. Dorsum convex, closely beset with papillæ. These look forward in the anterior, and backward in the posterior region, and are mostly united two by two at the base. In the rest of the dorsum 3—8 papillæ, jointed at the base, together form stellate figures like the petals of an open flower. In the interval between these composite papillæ, there are smaller ones. Calcareous deposits are dichotomously branched, slender, pointed, X-shaped spicules and aggregations of innumerable minute grains.

Remarks :—This is a very large-sized holothurian. Of the three specimens in alcohol, I measured two when living : they were both 35×10 cm. A third specimen in alcohol measures 28×11 cm.

The species has some extremely characteristic features by which it can be easily recognized. The whole dorsum is beset with large compound papillæ. They are several cm. across, with several rather acute lobes or processes, making a stellate figure. They are evidently formed by the uniting together of several pa-

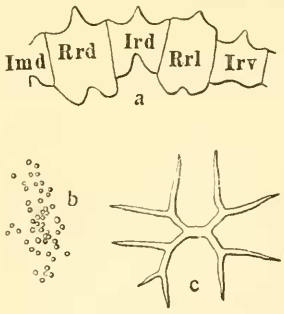
pillæ. They are largest and most developed in the middle part of the body, but become simpler toward the two extremities, and at the very front and posterior ends, are represented by large conical simple papillæ. The space between composite papillæ has many wart-like simple papillæ, which are 2—3 mm. across. The whole ventrum is closely beset with large pedicels, without any arrangement in rows. KENT gives a good photograph of the animal (Pl. XXXV., fig. B, named *Stichopus variegatus* by mistake) ; only in my specimens, the large compound papillæ are a little closer.

The ground color of the dorsum can best be likened to that of a ripe tomato, being of a peculiar yellowish red color. When kept in a vessel for some time, the yellowish tinge comes to predominate. In the space between large compound papillæ, there are many brown spots which correspond to wart-like simple papillæ. All over the dorsum, on the compound papillæ as well as in the interspace, there are numerous minute spots, yellow when living, and whitish in alcohol. They enclose each a minute opening and probably correspond to minute papillæ. Between warts, there are seen some irregular blackish-brown streaks which are especially prominent on the side of the body and can be seen best in life. The color and papillæ of the dorsum have been recently figured by SLUITER (1901*b*.). The color of the ventrum has a much more reddish tinge than that of the dorsum. The tentacle is yellow.

There are two kinds of calcareous deposits : (i) Slender X-shaped spicules whose ends divide dichotomously once or twice and are produced into long, fine tapering points (textfig. 25*c*). (ii) Innumerable minute grains (*b*), which, collected into aggrega-

tions, are scattered all over the perisome but at irregular intervals. The minute white spots which cover the dorsum seem to be due to aggregations of these grains. In the pedicels, I can detect no specially developed supporting rods: there seem to be only X-shaped spicules and minute grains, some of the former possibly somewhat thicker than in other parts. The end-plates are somewhat peculiar: instead of a plate with uniformly close net-work, there are centres of close net-work in the plate, and these are united with one another by looser net-work.

The calcareous ring is as shown in textfig. 25*a*. The mouth being ventral, the ring has an oblique position and the pieces are more or less oblique. The dorsal pieces are certainly larger than those of the ventral part. The stone-canal is fastened on the dorsal mesentery and the madreporic body is found on the edge of the opening in the mesentery close to the dorso-median piece of the calcareous ring. In one specimen, the proximal part of the stone-canal was distinctly white and calcareous and seemed even to stick out of the membrane. A membranous duct was formed as a continuation. In another specimen, there was no such peculiar arrangement. The Polian vesicles are in two bundles, one on each side of the ventral median line. Each bundle starts with a single stem, but soon divides. In one specimen, the right bundle had two long vesicles and one much shorter, which however had several small branches. The left bundle started also



Textfig. 25.

Stichopus ananas: *a*—Calcareous ring; *b*—Minute grains; *c*—X-shaped spicule. (*b*—*c* × 300). Imd—Middorsal interradialia; Ird—Right dorsal interradralia; Irv—Right ventral interradialia; Rrd—Right dorsal radialia; Rrl—Right lateral radialia.

with one stem, but soon divided into a large number of vesicles. No Cuvierian organ.

The present species and *Mülleria formosa* SELENKA coincide remarkably in the shape and character of the calcareous deposits and in the disposition of the dorsal papillæ. In fact, with the exception of the presence of anal teeth in the latter species, they are so entirely alike that one can not help entertaining a suspicion that the two species are identical. If they are really separate, such close resemblance must be considered a singular case of convergence. It is also a noteworthy fact that while the present species has been found in various parts of the world at various times from 1833 to 1901, *Mülleria formosa* has been found only twice in two widely separate localities, Mauritius (HAACKE '80) and Macassar (SELENKA '67), and in spite of many recent explorations not a single specimen has been reported either from intermediate spots or from any other localities. The original specimen described by SELENKA was strongly macerated. There are in my possession some dried specimens, which seem not unlikely referable to *M. formosa*, and yet I feel constrained to place them in the present species, especially after obtaining fresh specimens from the same localities and ascertaining them to be of the same species as those cured for market, which were once examined by Prof. SELENKA and were placed without any hesitation in *Mülleria formosa*. Taking all things into consideration, *Mülleria formosa* needs re-examination, and I should be not at all surprised if such a species should turn out to be non-existent.

The articles cured for market from the species are called "Gajimaru" or "Plum-blossom trepang" (梅花參), the latter name obviously referring to the clusters of papillæ. The value is 40—50 Yen per 100 Kin.

Locality:—Celebes (Jaeger '33); New Ireland (Quoy & Gaimard '33); Lugunor, Caroline Is. (Brandt '33); Polynesia (Selenka '67); Java (Selenka '67); Bay of Geelvink (Ludwig '82); Navigator Is. (Théel '86); Great Barrier Reef (Kent '93); Saleyer Is. (Sluiter : 01); Amboina (Sluiter : 01); Roma (Sluiter : 01); Nalahia Bai (Sluiter : 01); Pasir Pandjang (Sluiter : 01); Okinawa I.

35. *Stichopus californicus* (Stimpson).

(Textfig. 26).

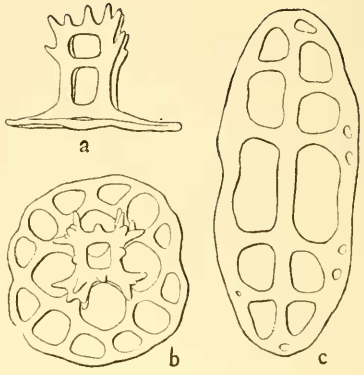
Holothuria californica Stimpson 1857, p. 528.—Selenka 1867, p. 331.—Lampert 1885, p. 93.—Théel 1886*a*, p. 239.

Stichopus californicus Clark 1901*a*, pp. 164, 171.—Clark 1901*d*, p. 496.

Specimens examined:—Two alcoholic specimens from Vancouver, received from the Department of Agriculture and Commerce, Apr. 26, 1897 (No. 1059). These two specimens are respectively about 19 and 18 cm. long in their somewhat macerated condition. Although there seem to be some points of difference, there can be no doubt that they belong to *Stichopus californicus* as redefined by Clark.

Description:—Tentacles 19. Stone-canal attached to the mesentery; madreporic body oblong and in the usual position. Polian vesicle one, long and large. The more dorsal radial pieces of the calcareous ring are higher than the more ventral ones. Ventral pedicels large and in three rows, the middle being twice as broad as the lateral; well-developed end-plates present. Large dorsal conical warts on the lateral edges and on the dorsal ambulacra. Small papillæ not discernible and probably absent. Calcareous deposits: Tables (textfig. 26*a*, *b*), in the outer layer slender and delicate; disk large, with four large central holes and some additional

circles and smooth margin; spire built of four pillars with one or two transverse beams; crown with comparatively long, pointed teeth, 16 or more in number. Buttons (*c*) in a layer below the tables, not thickly crowded but scattered more or less sparsely. They seem more numerous in the ventral perisome. Rather large, with 5—8 pairs of holes. I can hardly find any with nine pairs of holes as stated by CLARK. These buttons form the supporting rods of ventral pedicels which have well-formed end-plates.



Textfig. 26.

Stichopus californicus: *a*, *b*—Tables; *c*—Button. (×300).

Remarks:—STIMPSON's description is very unsatisfactory. It runs as follows: "Body much elongated, of nearly the same thickness throughout; below, flattened and thickly covered with stout sucker-bearing feet not arranged in rows. Dorsal surface with about forty large conical cutaneous processes (or false feet) sparingly scattered; between which there are numerous cirriform feet also diskless. Tentacula twenty, short, peltate with broad discs. Color reddish brown; below lighter. Length $1\frac{1}{2}$ feet; thickness $1\frac{1}{4}$ inches."

CLARK (1901*a*, pp. 164—165) says of the species: "Its position in the Genus *Stichopus* is suggested by the flattened ventral surface and the large warts and papillæ on the dorsal side, and is clearly proven by the arrangement of the genital gland in two tufts, one on each side of the mesentery. It reaches a length of over a foot and is dark brown in color. It is easily distinguished from other members of the genus by the remarkable calcareous de-

posits. In the outer layer of the body-wall are large numbers of well-developed tables, with discs which normally contain four central holes and four larger and eight smaller ones in the periphery; the spire terminates in 20—24 teeth and has one or two cross-bars. Underneath the tables is a layer of very numerous, long, thin buttons usually with nine pairs of holes. At the base of the tentacles and in the skin of the oral disc are numerous, slightly knobbed or branched rods, and there are numerous other rods somewhat similar to the supporting rods of the tentacles. The pedicels, however, seem to have no other supporting rods than the long buttons. The C-shaped bodies, such as are found in many species of *Stichopus*, seem to be wanting."

The species seems to bear a close resemblance to *Stichopus johnsoni* Théel reported from Santa Barbara, California. The relations of the two species ought to be re-examined.

Locality:—Puget Sound (Clark : 01); Tomales Bay, Cal. (Stimpson '57); Pacific Grove, Cal. (Clark : 01).

36. *Stichopus chloronotus* Brandt.

(Textfig. 27).

Stichopus (*Perideris*) *chloronotus* Brandt 1835, p. 50.—Lampert 1885, p. 107.—Théel 1886*a*, pp. 159, 189, Pl. VII., fig. 6.

Stichopus chloronotus Selenka 1867, pp. 315—6, Taf. XVII., Fig. 20—24, Taf. XVIII., Fig. 25.—Selenka 1868, p. 116.—Semper 1867—'68, pp. 74, 275.—Semper 1869, p. 120.—Ludwig 1881, p. 591.—Ludwig 1882, p. 133.—Ludwig 1883, pp. 157, 164.—Bell 1884, p. 509.—Bell 1886, p. 27.—Sluiter 1887, pp. 195—6.—Ludwig 1887*b*, p. 1224, Fig. 4.—Bell 1887*a*, p. 140.—Ludwig 1888, p. 812.—Bell 1888, p. 389.—Lampert 1889, p. 815.—Kent 1893, pp. 225, 240, Chr. XII., Fig. 3.—Sluiter 1894, p. 104.—Koehler

1895*a*, p. 285.—Koehler 1895*c*, p. 385.—Sluiter 1895, p. 79.—Ludwig 1899, p. 561.—Bedford 1899*b*, p. 150.—Sluiter 1901*b*, p. 31.

Stichopus cylindricus Haacke 1880, pp. 46—7.

Stichopus chloronotos Ludwig 1889—'92, p. 331.

Specimens examined :—

Sci. Coll., Spec. No.	No. of individuals	Preservation	Locality	Collector	Date
1189	1	Alc.	Satsukawa, Amami-Ōshima.	Mitsukuri, Ikeda et al.	Mar. 31, : 01.
Agassiz 20	1	,,	Uola, Carolines.	A. Agassiz	1899—1900.

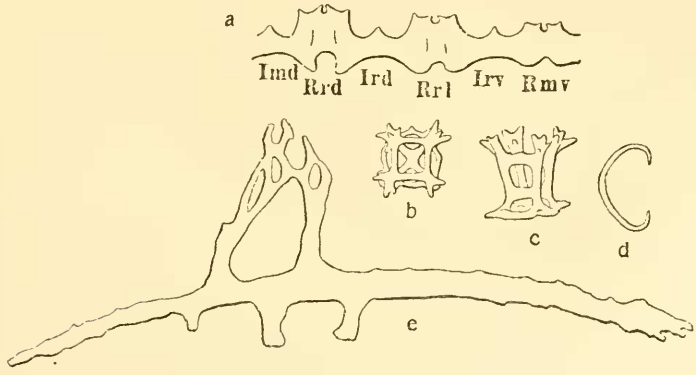
Description :—Tentacles 20. Papillæ on rather prominent conical warts, forming a double row along each dorsal ambulacrum, and a zigzag or double row along each side of the body. Mouth surrounded by a circle of papillæ. Numerous pedicels of the ventrum arranged in three longitudinal rows of which the middle one is about twice as broad as the two lateral ones. Tables very delicate with the spire terminating in 8—12 teeth. Numerous C-shaped bodies present. Rosettes formed by the union of C-shaped bodies rarely present (Théel, Sluiter, Ludwig). In the muscles and viscera, rod-shaped, smooth or thorny bodies. In the wall of the pedicels, thorny and latticed supporting rods. Polian vesicles three. One stone-canal attached to the mesentery. Color olive-green. Length 20 cm.

Remarks :—The color of the animal, when alive, is stated by Kent to be clear bottle-green throughout, and the extreme tips of the papillæ orange or scarlet. The Ōshima specimen, which I was able to observe alive, was deep black with a bluish tinge, the tips of some papillæ being ochre-yellow, so that there seems to be some variation in these respects. In alcohol the color has entire-

ly faded, and both the preserved specimens in hand are light brown.

The body is angular and quadrilateral in section. Along each of the two dorsal and two lateral ambulacra an alternate row of large papillæ (ca. 2 cm. high) is found. The whole length of the Ōshima specimen when living was 30 cm., but has shrunk to 15 ×7 cm. in alcohol.

Calcareous bodies are tables and C-shaped bodies. Tables are all of slender build (textfig. 27 *b*, *c*). The disk is rather small being about 0.028 mm. across, and having, in addition to four large holes, only four other openings, or at the most one more or less incomplete additional circle of openings. The spire is about 0.032 mm. in height, built of four slender pillars and having only one cross-beam. The crown appears to be somewhat flared out, and the teeth number eight (in which case two stick out laterally from each angle) or twelve (in which case an additional tooth is directed upward from each angle), all pointing away from one another. The C-shaped bodies (*d*) are in a layer below the tables, and are scattered irregularly. Their size



Textfig. 27.

Stichopus chloronotus: *a*—Calcareous ring; *b*, *c*—Tables of dorsum; *d*—C-shaped body; *e*—Supporting rod. (*b*—*e* ×240). Imd—Middorsal interradialia; Ird—Right dorsal interradialia; Irv—Right ventral interradialia; Rmv—Midventral radialia; Rrd—Right dorsal radialia; Rrl—Right lateral radialia.

is rather small and remarkably uniform being ± 0.035 mm. Like THÉEL, SLUITER and LUDWIG, I have been able to detect occasionally rosettes which are formed by the combination of C-shaped bodies. In the pedicels, tables with reduced spire and much larger disk than in those in other parts are present. Also large supporting rods with serrated margin and irregular fenestrated expansions, generally on one side of the middle part, are present (*e*).

Polian vesicles three. Stone-canal one, attached to the mesentery, much meandering in its course, with a large madreporic body. Calcareous ring as figured in textfig. 27*a*.

The animal lives in shallow water. The native name in Ōshima is "Kuromi-Shikiri"; this however is equally applicable to other black-colored species.

In the Ōshima specimen, a *Fierasfer* came out from the cloaca.

Locality:—Zanzibar (SELENKA '67); Querimba (SEMPER '69); Mozambique (SEMPER '69); Seychelles (LAMPERT '85); Darros I. (BELL '84); Mauritius (HAACKE '80, LUDWIG '83); Indian Ocean (LUDWIG '82); Ceylon (LUDWIG '87); Andaman Is. (BELL '87); Bay of Bengal (BELL '88); Elphinstone I., Mergui Arch. (BELL '86); Nicobar (THÉEL & LAMPERT); Pulo Tikul (THÉEL & LAMPERT); Pulo Edam (LUDWIG '88); Java (SLUITER '95); Bay of Batavia (SLUITER '95); Sunda Is. (KOEHLER '95); Sebang Kotang (SLUITER : 01); Lumu-Lumu (SLUITER : 01); Kabala dua (SLUITER : 01); Karakelang (SLUITER : 01); Sarasa (SLUITER : 01); Pepela Bai (SLUITER : 01); East Timor (SLUITER : 01); Amboina (SLUITER '94, KOEHLER '95, SLUITER : 01); Moluccas (SEMPER '67—8); Macassar (LUDWIG '82); Lugunor & Guahan (BRANDT '35); Pelew Is. (THÉEL & LAMPERT); Torres Strait (KENT '93); Great Barrier Reef (KENT '93); Lifu, Loyalty Is. (BEDFORD '99); Fiji (SEMPER '67—8, THÉEL '86, LAMPERT '89); Samoa (SEMPER '67—8, LAMPERT '85); Tongatabu, Friendly Is. (THÉEL '85); Sandwich Is. (SELENKA '67); Carolines; Amami-Ōshima.

37. *Stichopus hirotai*, sp. n.

(Textfig. 28).

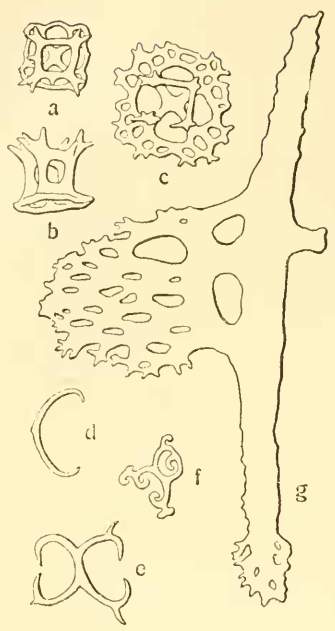
Specimens examined :—

Sci. Coll., Spec. No.	No. of individuals	Preservation	Locality	Collector	Date
1058	6	Alc.	Futami Harbor, Chichijima, Ogasawara Is.	Hirota & Sekiguchi	Apr., '94.
1326	11	„	?*		'80 ?
1342	3	„	Ōgiura, Chichijima, Ogasawara Is.	Tokunaga	

Description :—Tentacles 18. Dorsal papillæ on conical warts of some mm. diameter ; arranged in rows on the two dorsal ambulacra and on the lateral edges of the dorsal surface ; no papillæ in the intervening spaces. Ventral pedicels numerous, in three zones, each with several rows of them. The median twice as broad as the two lateral zones. Polian vesicles in one specimen three, of which two were large and one small. Stone-canal attached to the mesentery, meandering greatly in its course. Madreporic body somewhat large. Calcareous ring as in the allied species : radialia four-pointed, interradialia single-pointed, somewhat oblique, the dorsal part being higher than the ventral part. The posterior prolongations of the radialia grow gradually larger toward the dorsal part.

Calcareous deposits :—(i) Slender, delicate tables with the disk mostly small, almost quadrangular in shape, about 0.028 mm. (textfig. 28*a*, *b*). Those on ventral pedicels up to

* The specimens are marked "Tokyo Market" which, I am certain, is a mistake ; they were probably collected by Sasaki and party in the Ogasawara Is.



Textfig. 28.

Stichopus hirotai: *a*, *b*—Tables of perisome; *c*—Same of pedicel; *d*—C-shaped body; *e*, *f*—Rosettes; *g*—Supporting rod. (*a*—*f* × 320; *g* × 240).

0.052—0.060 mm. or more (*c*). The spire is often absent or is represented merely by four knobs. When present it is rarely formed of five columns; about 0.035 mm. high, with one cross-beam and twelve or more points, expanded above. I can not discover any conical tables. (ii) C-shaped bodies numerous, usually small, measuring about 0.032—0.36 mm. (*d*). (iii) Rosettes not numerous but not rare (*f*), not much smaller than C-shaped bodies, and some at least formed apparently by combinations of the latter (*e*). Supporting rods in pedicels 0.4 mm. or more (*g*).

Size of body up to 10 cm. in alcohol. Color uniformly light brown in alcohol. Skin soft and flaccid.

Remarks:—This species is nearest to *Stichopus horrens* SELENKA, from which it differs only in two points: (1) in having 18 tentacles instead of 20, and (2) in the calcareous deposits. In *S. horrens* C-shaped bodies are 0.1 mm. long, and tables are of three kinds: (a) ordinary delicate ones, (b) similar but larger ones distributed among (a) at regular intervals, and (c) large conical ones. Whereas, in the present species I can find only two kinds: (a) ordinary kind and (b) larger disked ones, mostly with imperfect spires and found in ventral pedicels, especially near the end-disks. Conical tables can not be found. C-shaped bodies are much smaller than in *S. horrens*.

The original specimen of SELENKA was only 5 cm. long. The only other investigator who has examined this species is LAMPERT, and he also gives 5 cm. as the average length of the species. Now it is possible that the difference in the calcareous deposits of this species and *S. horrens* is due simply to a difference in age. The number of tentacles is not a wholly reliable character. It is therefore possible that this species may prove to be the same as *S. horrens* or only a variety of it. But at present, the differences are too great and leave no choice but to describe this as a new species. An individual in lot No. 1342, 4 cm. long, does not show any large tables distributed at regular intervals, nor any conical tables at the base of the pedicels.

A *Fierasfer* is said to have come out of specimen No. 1342.

I have pleasure in naming this species after the late Mr. HIROTA, a friend and pupil of mine, who spent some time exploring the Ogasawara Islands and collected a set of the specimens under consideration. His untimely death cut off a career of much promise.

38. *Stichopus japonicus* SELENKA.

(Pl. IV., figs. 32—44 ; textfig. 29).

Stichopus japonicus SELENKA 1867, p. 318, Taf. XVIII., Fig. 33-36. —SEMPER 1867—'68, p. 74.—v.MARENZELLER 1881, p. 136, Taf. V., Fig. 11.—LAMPERT 1885, p. 104.—THÉEL, 1886*a*, pp. 160, 194, Pl. VII., fig. 3.—LUDWIG 1887*b*, p. 1242.—LUDWIG 1889—'92, p. 331.—MITSUKURI 1896, p. 408.—MITSUKURI 1897*a*, p. 31.—ÖSTERGREN 1898, p. 134.—SLUITER 1901*b*, p. 142.—CLARK 1902*a*, p. 563.

Holothuria armata SELENKA 1867, p. 330, Taf. XVIII., Fig. 66.—LAMPERT 1885, p. 91.

Stichopus armatus ? SEMPER 1867—'68, p. 75.—v. MARENZELLER 1881, p. 121.

Stichopus (Holothuria) armatus THÉEL 1886*a*, p. 196.—MITSUKURI 1896, p. 408.

Stichopus japonicus, var. *typicus* THÉEL 1886*a*, p. 161, Pl. VIII., fig. 2.

Specimens examined :—

From Hokkaidō and Saghalien.

Sci. Coll., Spec. No.	No. of individuals	Preservation	Locality	Collector	Date
1137	1	Alc.	Kabuka, Rēbun I.	Nozawa	
1345	2	„	Shikuzushi, Prov. Shiribeshi.	„	Jun. 10, : 93.
1346	5	Dried	Otaru	Watase	
1347	1	„	Rijiri I., Prov. Kitami.		
1348	1	„	Kunajiri I., Chishima.		
1613	3	„	Dofuchi Lagoon, Saghalien.	Kishinouye	Nov. 13, : 95.

From the Sea of Japan.

Sci. Coll., Spec. No.	No. of individuals	Preservation	Locality	Collector	Date
1350	2	Alc.	Mano Bay, Sado I.	Kitahara	Mar., : 00.
1351	3	„	Nakai, Nanao Bay, Prov. Noto.		Feb., : 01.
1352	2	Dried	Niigata		
1354	6	Alc.	Nako, Abu Distr., Prov. Nagato.	Nakamura	1900
1355	2	„	Izuhara, Tsushima Is.	Namiye & Tsuchida	Feb., : 92.
1356	6	„	Mitsushima, Waniura, Tsushima Is.	„	Mar., : 92.
1357—1358	2	Dried	Mukatsuku, Prov. Nagato.		
1359	4	„	Nakai, Prov. Noto.	Ishimura	

Sci. Coll., Spec. No.	No. of individuals	Preservation	Locality	Collector	Date
1360	1	Dried	Prov. Tango.		
1361—1362	2 lots	„	Shimane Prefecture		
1363	2	„	Nishiura, Prov. Noto.		

From the Pacific Coast of Japan.

Sci. Coll., Spec. No.	No. of individuals	Preservation	Locality	Collector	Date
1265	3	Alc.	Ōminato, Aomori Bay.	I. Ikeda	Jul., : 00.
1370	5	Dried	„	„	Jul. & Sept, : 00.
1373	1	„	Aburakawa. Prov. Mutsu.		
1367	4	Alc.	Aomori Market	Nishikawa	Jan. 3, : 01.
1374	2	Dried	Aomori Prefecture		
1368	1	Alc.	Samé Harbor, Aomori Prefecture.	Nishikawa	Jan. 1, : 01.
1375	1	Dried	Kesen Distr., Rikuzen.		
1070	2	Alc.	Kotake, near Ishinomaki, Prov. Rikuzen.	Izuka	Jul. 2, '99.
1376	3	Dried	Miyagi Prefecture		
	Numerous		Tokyo Market		From time to time
1337	1	Alc.	„		
1377	Many	„	Kominato, Prov. Awa.	Ishikawa & Okada	Apr., '85.
1380	4	„	Kōzu I., Prov. Izu.		
1334	1	„	Shinojima, Prov. Owari.	Ōtaki	Dec. 11, : 02.

Sci. Coll., Spec. No.	No. of individuals	Preservation	Locality	Collector	Date
1381	1	Alc.	Niijima I., Prov. Izu.	Mizukoshi	
1382	Several	,,	Enoura, Prov. Suruga.	Mitsukuri	Apr., '84.
1383	5	,,	Ōshima, Prov. Izu.		
1384	4	,,	Himejima, Prov. Mikawa.	Mitsukuri	Dec. 31, '95.
1385	6	,,	Toyohama, Chita Distr. Prov. Owari.	Sasaki	Sept. 23, '96.
1386	1	,,	Sakunoshima, Prov. Mikawa.	Mitsukuri	Dec. 27, '95.
	Numerous	,,	Kanagawa & Yokohama		
	,,	,,	Misaki		
1395—1396	8	,,	Kanagawa, Prov. Musashi.		

From the Inland Sea.

Sci. Coll., Spec. No.	No. of individuals	Preservation	Locality	Collector	Date
1269	1	Alc.	Naruto, Prov. Awa.	Izuka	Apr. 5, : 01.
1421	2	Dried	Hyōgo (Market ?)		
1420	1	,,	Aioi, Akō Distr., Prov. Harima.		
1365	Many	Alc.	Yamaguchi Market	Inaba	

From Kyūshū.

Sci. Coll., Spec. No.	No. of individuals	Preservation	Locality	Collector	Date
1422	3	Dried	Fukuoka (Market ?)		
1423—1424	4	,,	Nagasaki Prefecture		

Sci. Coll., Spec. No.	No. of individuals	Preservation	Locality	Collector	Date
1425	1	Dried	Kita-matsuura Distr., Prov. Hizen.		
1426	2	Alc.	Beppu, Prov. Bungo.	Terazaki	Mar. 13, '99.
1427	1	Dried	Minami Kaibe Distr., Prov. Bungo.		
1428	2	„	Ōita Prefecture		
1439	1	Alc.	Enoshima, Kagoshima Bay.	Mitsukuri & Hara	Mar. 31, '96.
1429	2	„	Kagoshima	S. Ikeda	Jan. 27, : 03.

From abroad.

Sci. Coll., Spec. No.	No. of individuals	Preservation	Locality	Collector
1430	5	Dried	Vladivostok	Kishinouye
1431	3	„	Myöng-chhyön, Ham-gyöng Do, Korea.	„
1432	5	„	Wön-san, Korea.	„
1433	5	„	Yöng-il (Unkofsky Bay), Kyöng-syang Do, Korea.	„
1434—1435	5	„	Kang-uön Do, Korea.	„
1436	5	„	Pusan, Korea.	„
1437	5	„	Chyöi-jyu (Quelpart I.), Korea.	„

*Remarks** :—The measurements of some of the largest specimens in my records taken when living, are (in cm.) 26×7 ; 32×9 ; 38×9.5 ; 43×7 ; 40×8. Stone-canal attached to the mesentery.

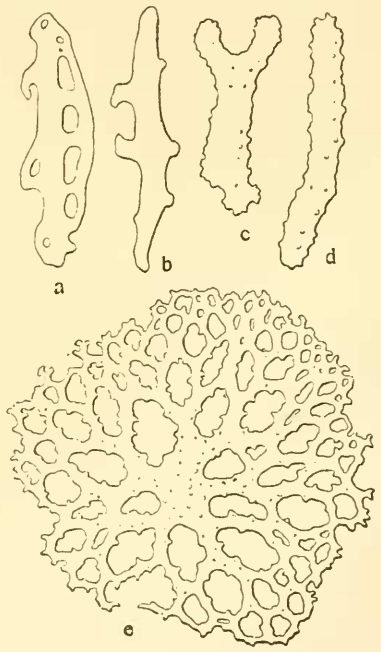
* For the literature on the species and the reason that *Holothuria armata* Selenka and *Stichopus japonicus* var. *typicus* Théel are made synonyms of the present species, see Mitsukuri 1897*a*, p. 31—42.

Its course is much convoluted. The madreporic body is pear-shaped, situated opposite the opening in the mesentery facing the middorsal interradius. Polian vesicle one, large, on the median ventral ambulacrum. In one specimen, there was a second small one on the left ventral interambulacrum. Calcareous ring, as in many other *Stichopus*-species, has the dorsal part pushed further forward than the ventral part. Hence, all the pieces except the two on the ventral and dorsal median lines are obliquely disposed. SELENKA's statements that the interradialia are broader than the radialia has been thought by v. MARENZELLER to be incorrect, which opinion I must share. Color varies greatly. I have seen two specimens (No. 1409) which are entirely white and must be considered as "albinos." Again there are specimens which are of a deep, dark color approaching black without a single lighter spot. The most usual colorations are as follows : Those that live among rocks along a rocky beach have the dorsal surface of a variegated, mottled appearance with darker and lighter patches produced by the intermingling of brown and maroon. The animal looks like rocks overgrown or encrusted at spots with small algæ and other marine organisms, the coloration without doubt serving as a protection. Individuals of this coloration seem moreover to have a larger number of tall papillæ. The ventral surface is of a red color with the tips of the tube-feet white. Those that live on sandy or muddy ground, probably among sea-weeds, have generally a uniform dark-green color, so much so that they are known in common Japanese as "Ao-namako" (green holothurian). These seem to have fewer and shorter papillæ.

The specimens from Hokkaidō and the northernmost part of Honshū have taller and more numerous papillæ, which are most conspicuous in dried specimens. In those specimens, the papillæ

are in four rows, along the two dorsal ambulacra and the lateral margins, with many smaller ones interspersed between them. This form was distinguished by SELENKA as *H. armata*. In the specimens from more southern parts, the papillæ become shorter and fewer. Some individuals seem even entirely smooth. This is the form which I propose to call *australis*. It seems to me probable that while the *armata*-form alone is found in Northern Japan, both *armata*- and *australis*-forms are found in the southern parts. They are not varieties in the sense that they are different from the typical form of the species, but rather they are the two extremities of a large group of forms all connected by intermediate forms. The difference seems to be correlated with their habitat, as indicated above.

I have stated already in a former paper that the calcareous deposits of this species change with age (MITSUKURI 1897*a*, pp. 35-41). Besides the tables, there are a few supporting rods in the ventral pedicels (textfig. 29 *a*, *b*). They are more numerous in the dorsal papillæ, most of which possess very small end-plates. Numerous, very complex-figured calcareous bodies in the cloacal wall (*e*). They extend up into the larger branches of the respiratory tree, gradually diminishing in number as they ascend in the tree. Reproductive



Textfig. 29.

Stichopus japonicus: *a*, *b*—Supporting rods of pedicel; *c*, *d*—Rods from genital tubes; *e*—Complex plate from cloacal wall. (×300).

organs and intestinal walls have simple curved rods (*c*, *d*). No calcareous bodies are found in the peritoneum or in the tentacular ampullæ.

Habitat: They are most abundant along the coast, among rocks which are full of nooks, crevices, and dark holes, or in sheltered localities such as harbors, inlets, etc. They seem never to be found on an open sandy shore with surf. As a general thing, they do not descend very deep, being found at the most at only a few fathoms' depth. Somewhat exceptional, therefore, are the two specimens (No. 1398) obtained off Jōgashima, Misaki, at 60 fathoms' depth by a fisherman's long-line.

This is par excellence *the* Japanese species of the Holothurians. Its name "Namako" has been made in the Japanese language synonymous with the name of the order. As the accompanying list shows, it is found in every part of Japan. The most northern points from which I have specimens are Rēbun I., Rijiri I., and Kunajiri I. How much further north the species extends, whether it is found in the more northerly islands of the Kuriles and in Saghalien, I have unfortunately no means of ascertaining at present. The most southern point in Japan from which I have specimens is Kagoshima. It may extend a little further south into Tanegashima and other small islands, but I am certain that it does not occur in Ōshima or in the Liu-Kiu Islands; for although I have collected there myself, and have seen many collections from there made by competent naturalists and have often examined cured trepangs from the islands, I have never yet come across a single specimen of this species. There are in the Science College collection two lots of dried specimens of this species from Taipeh in Formosa, which were exhibited at the Second National Fisheries Exhibit at Kobe, but the labels accom-

panying them which were made at the Exhibition state particularly that the localities from which they came were not ascertainable, and it is probable that they were exhibited simply as merchandise sold in Taipeh. I have therefore no specimen which is certainly known to have come from points further south than Kagoshima.

Outside of Japan, I have specimens from Vladivostok, and from different points on the eastern coast of Korea facing the Sea of Japan, most of these specimens being those dried by the Japanese fishermen who go out to these parts, so that the species is found all around the shores of the same sea. I have no specimen from the western coast of Korea or from any spot on the Yellow Sea or from any place in China. These parts have simply not been explored, and whether the species extends to them or not I have no means of ascertaining. So far as my present experience goes, the species is confined to Japan proper and to the coast of the Asiatic continent facing the Sea of Japan. Remarkable, therefore, is the locality given by THÉEL, viz. Hong-Kong, especially as I have been unable to find any in the Liu-Kiu Islands.

Locality:—Japan (SELENKA '67, v. MARENZELLER '81, THÉEL '86); Hakodaté (SELENKA '67); Northern Japan (LAMPERT '85); Amboina? (LAMPERT '85); Yokohama (LUDWIG '87); Hong Kong (THÉEL '86); Sitka (CLARK: 02); Saghalien; Kiūshū; Vladivostok; Eastern Coast of Korea.

39. *Stichopus oshimæ*, sp. n.

(Textfig. 30).

Specimens examined:—5 specimens from Katsuyoki, Kageroma I. in Ōshima, obtained near shore in 1—3 fathoms. Collected by Mitsukuri and S. Ikeda. Apr. 1, 1901. (Sci. Coll., Spec. No. 1325).

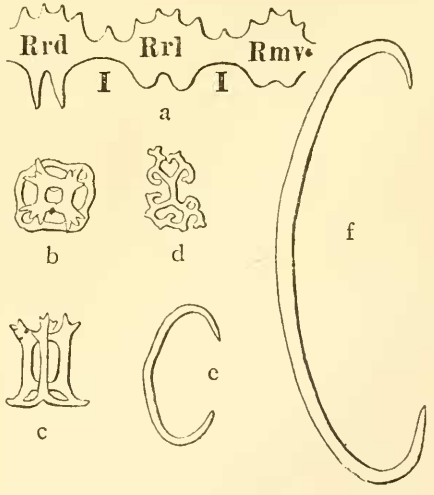
Description :—The four specimens measured were respectively 18 × 4 cm., 14 × 4 cm., 15 × 4.5 cm., and 15 × 4 cm. Tentacles 20. Body, as viewed from above, somewhat narrowed toward the posterior end. The dorsal and ventral surfaces are clearly marked off from each other by a series of large papillæ which project laterally and make up the edge of the body. The papillæ are not all single, but sometimes two or more are united together, a membrane going round the anterior end. The whole dorsal surface together with the lateral papillæ may be described as variegated in color, presenting various shades of brown or yellowish-brown, on the whole growing darker toward the posterior end in all the five individuals. The dorsum is roughly divided into right and left halves by an irregular broken black line running along the dorsal median part and sending out irregular branches towards both sides. This line may be taken to represent the median dorsal interradius, and the two halves of the dorsum the lateral dorsal ambulacra. The large and small papillæ, scattered irregularly over these halves, therefore, belong to the dorsal ambulacra. These papillæ are comparatively large, some being more than 1 cm. in height, quite thick at the base and conical in shape. Although generally single, some of them are double, two starting from a common base. They are not very numerous. Their tips were sometimes black, but oftener reddish-brown, and the surface of all the papillæ was marked by incomplete and unclosed dark rings.

There are some strikingly characteristic points on the ventral surface. The mouth is surrounded by a membrane. The general color was a somewhat dark brown, but there were dark patches. In one specimen there were two pairs of black patches on the anterior two-thirds, while the posterior one-third was entirely

black. The pedicels in the former parts are closely set in three zones, while in the latter they are markedly more sparse: in this part, the middle zone presents an irregular double row of them, while in the lateral zones they are very much reduced in number, or one or both of the lateral zones are entirely absent. The posterior third therefore presents a striking appearance. It will be remembered that very much the same thing was described for *Stichopus naso* SEMPER, which however narrows toward the *anterior* end and not toward the *posterior* as in this species.

Color of the tentacles reddish brown. Polian vesicles six. Calcareous ring as indicated in textfig. 30 *a*., resembling that of *S. variegatus* SEMPER, *S. naso* SEMPER, etc. It is oblique, the posterior prolongations of the radialia becoming longer dorsally. Stone-canal attached to the mesentery, much meandering.

Calcareous deposits: (i) C-shaped bodies of various sizes, measuring 0.052 — 0.144 mm., and frequently bent a little at the center (*e*, *f*). (ii) Rosettes very numerous, much smaller than C-shaped bodies (*d*). (iii) Tables delicate, slender; disk small, 0.02 mm. in diameter; spire 0.032 mm., 12 or more toothed, teeth spreading outward and reminding one of a stag's horn (*b*, *c*).



Textfig. 30.

Stichopus oshimae: *a*—Calcareous ring; *b*, *c*—Tables; *d*—Rosette; *e*, *f*—C-shaped bodies. (*b*—*f* × 400). I—Interradialia; Rmv—Midventral radialia; Rrd—Right dorsal radialia; Rrl—Right lateral radialia.

Remarks:—All the specimens were obtained in 1—3 fathoms

of water by spearing from the boat. Unfortunately, all the specimens became very much distorted during their transmission to Tokyo.

Although I obtained this species only in Ōshima, there is very little doubt that it occurs in the Liu-Kiu group also; for when I showed my sketch of this species to NABISA, an intelligent native fisherman, he at once recognized it and said that in his part of the islands it was called "Daru-ga," meaning "skin that hangs down."

This species evidently belongs to that group of the *Stichopus*-species which have as their calcareous deposits C-shaped bodies and one or more kinds of tables with or without incomplete rosettes, and which are very difficult to distinguish from one another. It seems very probable that some of these species will be found to be synonyms representing different ages or mere local varieties of one and the same species. The present species can not be identified with any of the species hitherto described. While I am prepared to learn that it is identical with one of the already known species, I have at present no grounds for thinking so; and as there are well-marked differences from any of the species already described, I have no choice but to describe this as a distinct and new species.

The species is certainly close to *S. variegatus* and perhaps closest to *S. naso*.

The species is called "Gazumaru" in Japan.

40. *Stichopus owstoni,* sp. n.

(Pl. II., figs. 18—20; textfig. 31.)

Specimens examined :—

Sci. Coll., Spec. No.	No. of individuals.	Preservation	Locality	Depth in *hiro*	Collector	Date
1053	2	Alc.	Naka-no-Yodomi, Sagami Sea.	70—100	Mitsukuri	Apr. 2, '99.
1054	1	„	Outside Okinosé, Iwado-line, Sagami Sea.		Aoki	May, '95.
1333	3	„	Off Misaki, Iwado-line, Sagami Sea.	60	„	Dec. 18, '02.
1057	1	„	Yodomi, Sagami Sea.	400?	„	Mar. 15,?
1331	1	„	Maye-no-Yodomi, Sagami Sea.	200	„	Jan. 13, '97.
1330	1	„	Enoshima, Sagami Bay.		Owston	
1332	7	„	Nishiura, Prov. Noto.	70	Shioi	
1056	1	„	Dōketsuba, Tokyo Bay.	200	Aoki	Dec. 6,?
1061—1062	2 lots	Dried	Prov. Noto			
1353	2	„	Shimoniikawa Distr., Prov. Ettchū.			Autumn, '00.
1271	2	„	Aomori Prefecture			
1372	2	„	„			
1640	4	Alc.	Isohama, Ibaraki Prefecture.		Sasaki	

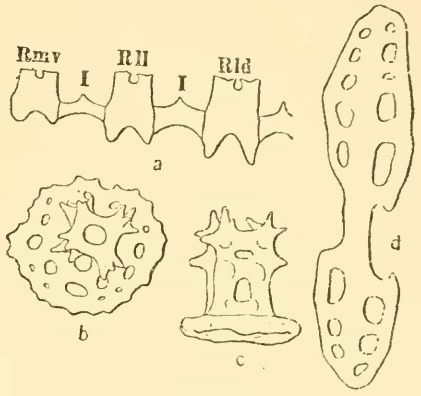
Description :—Tentacles 20. Body semicylindrical, i.e., dorsum vaulted and ventrum flat. In life, one specimen measured 41 × 10 cm. and another 33 × 6 cm. Color in life greenish with dark-

shaded papillæ; in alcohol, uniform grey with slightly darker papillæ. Pedicels in three longitudinal bands, the middle band twice as broad as the lateral band. Scattered among these pedicels numerous dark spots which look indented. These are probably small pedicels or papillæ. At the lateral edges large conical papillæ in a row, 7—10 mm. in height, 17 or 18 in number. Smaller papillæ of various sizes scattered all over the dorsal surface, the tallest of these being very much smaller than the lateral papillæ. In specimens observed in life, some of the taller of these dorsal papillæ were arranged in a more or less irregular double row along each of the two dorsal ambulacral lines. Smaller papillæ were scattered all over the dorsal surface. In some specimens, these smaller ones were more or less in a straight line along the lines of the taller papillæ (dorsal ambulacral), so that longitudinal lines of black dots were noticeable, especially when contracted. In other specimens no such arrangement could be observed. Around the subventral mouth, a crown of tentacles, surrounded by a membrane fringed with 25 or more medium-sized papillæ, these being more conspicuous on the dorsal and lateral parts and rudimentary on the ventral part of the membrane. Anus terminal, subdorsal, with some large papillæ in the neighborhood.

Genital bundles two. Stone-canal attached to the mesentery. Madreporic body as usual, near the opening in the mesentery opposite the middorsal interradial piece of the calcareous ring. Polian vesicles variable in number. In one (No. 1054) there are four, of which one is large, two middle-sized, and one small. In another (No. 1053) only one. In a third (No. 1332) two large vesicles united at the base into a single tube. Calcareous ring as given in textfig. 31*a*. Both radial and interradial pieces of the

dorsal part are taller than the ventral ones.

Calcareous deposits :—Over the general surface of the body there are to be found tables only (*b*, *c*). Disk well-developed, 0.06—0.85 mm. in diameter. Around the four large central holes, one or two more or less incomplete circles of smaller holes with indented margin. Spire well-developed, built of four pillars, but not rarely of five, 0.048 mm. high ; nearly all with two transverse beams, with teeth on each beam. A top view gives 8—12 or more teeth. There seem to be no noticeable difference in the tables of the dorsal and ventral surfaces, but if anything, there are more tables with smaller disk in the ventral than in the dorsal perisome. In the dorsal papillæ, end-plates none or very slightly developed. In the ventral pedicels, end-plates well-developed, with similar supporting rods. No calcareous bodies in the peritoneal membrane or Polian vesicle. Beautiful complex calcareous deposits in the cloacal wall and respiratory tree.



Textfig. 31.

Stichopus owstoni : *a*—Calcareous ring ; *b,c*—Tables ; *d*—Supporting rod of dorsal papilla. (*b—d* × 300). I—Interradialia ; RId—Left dorsal radialia ; RII—Left lateral radialia ; Rmv—Mid-ventral radialia.

Remarks :—In the specimens from the north, there are many tables with five pillars and others with six, seven, eight, or only three. This is especially noticeable in No. 1372, in which tables with four pillars are not common. Aoki observed a *Fierasfer* come out from one of the specimens (1333).

Found so far in 80—100 fathoms or deeper waters of the Sagami Sea. Rather common. Taken in numbers by "Teguri".

nets in Yodomi in 80 fathoms. Strangely enough, the species is also found in about the same depth in the Japan Sea in Hakui District, Province of Noto, for the specimens from which locality I am indebted to the goodwill of Mr. Y. Shioi. There the specimens, dried for commerce, are known as "Mukade-iriko." It is therefore reasonable to suppose that the species will be found in intermediate stations.

This species is near to *Stichopus griegi* Östergren, but I can not detect any X-shaped spicules below the layer of tables. Moreover the calcareous bodies in the cloacal wall, etc., are much more complex than in that species.

I have pleasure in naming this after my friend, Mr. A. Owston, who has been instrumental in bringing up many treasures from the depths of the Sagami Sea, and to whom I owe some specimens of this species.

41. *Stichopus variegatus* Semper.

(Textfig. 32).

Stichopus variegatus Semper 1867—'68, pp. 73, 246—7, 275, Taf. XVI., XXX., Figs. 1—6; Taf. XXXI., Figs. 2, 3, 6, 9; Taf. XXXII., Figs. 1, 3, 5; Taf. XXXIII., Figs. 4, 5, 6, 9, 17; Taf. XXXV., Figs. 1, 11, 12, 13; Taf. XXXVI., Fig. 1; Taf. XXXVIII., Fig. 10.—Ludwig 1882, p. 134.—Ludwig 1883, pp. 156—7, 164.—Bell 1884, p. 151.—Lampert 1885, p. 105.—Théel 1886*a*, pp. 162, 191, Pl. VII., fig. 7.—Bell 1887*a*, p. 140.—Ludwig 1887*b*, pp. 1224, 1242.—Sluiter 1887, p. 196.—Bell 1888, p. 389.—Ludwig 1888, p. 811.—Lampert 1889, p. 814.—Ludwig 1889—'92, p. 331.—Kent 1893, pp. 57, 226, 234, Pl. XXXV., fig. B.—Sluiter 1894, p. 104.—Sluiter 1895, p. 79.—Koehler 1895*c*, p. 384.—Lampert 1896 p. 59.—Ludwig 1899, p. 561.—Sluiter 1901*b*, p. 31.

Stichopus variegatus var. *herrmanni* Semper 1867—'68, pp. 73—4, 275,

Taf. XVII., XXX., Fig. 2.—Lampert 1885, p. 106.—Lampert 1889, p. 814.
Stichopus naso Haacke 1880, p. 46.

Specimens examined :—

Sci. Coll., Spec. No.	No. of individuals	Preservation	Locality	Collector	Date
1263	2	Alc.	Torres Strait	Nishikawa	Apr., '02.
1264	1	,,	,,	,,	,,
1329	1	,,	Sanbon Rock near Kōzushima, Izu.	Aoki	June 15, '00.
1335	1	,,	Futami Harbor, Ogasawara Is.	Hirota & Sekiguchi	Apr. 9, '94.

Description :—Tentacles 20. Body bluntly four-sided ; ventrum flat ; dorsum very high and closely beset with numerous small round papillæ. The sides and anterior end of the body thin out almost membrane-like, and the tentacular circle is surrounded by the flat membranous fold of the anterior body-end. Sexual opening on a distinct wart.

The ground color of the body yellowish-grey with darker brownish spots and net-like tracings. Tips of the papillæ deep-red. Ventrum uniformly whitish-grey. Polian vesicles two. Stone-canal attached. Calcareous deposits are C-shaped bodies and tables, the latter with truncated spire terminating in four dentate points. Incomplete rosettes numerous. Size up to 3 feet. 0—10 fathoms.

Remarks :—It is with a great deal of doubt that I refer the Sanbon specimen to this species. Calcareous bodies have been partly dissolved, and I am unable to make out the finer points of the tables. There are simple disks mostly with four central holes ; others have dissolved retaining only the X-like shape.

The spire is also reduced mostly to four knobs, but from the most complete ones, I am able to make out that they resemble closely the tables of the group of *Stichopus* to which *S. variegatus* belongs. There are also C-shaped bodies about 0.08 mm. long, like those in *S. variegatus* and somewhat larger than those seen in *S. chlorenotus*. They are tolerably numerous. There are also rosettes scattered in moderate abundance. They are mostly smaller than the C-shaped bodies. Large ventral pedicels are in three distinct rows, of which the middle one is twice as broad as the lateral. On the dorsum, there are large wart-like papillæ whose arrangement I can not make out distinctly owing to the distortion of the specimen, but which seem to be confined to the two dorsal ambulacra. The lateral edges (between the dorsum and the ventrum) have only a few large warts distributed widely apart. Numerous smaller papillæ seem to be scattered all over the dorsum. On the whole, the specimen seems to agree best with the description of *Stichopus variegatus*.

The specimen from the Ogasawara Is. also probably belongs to this species, although it may possibly represent *S. naso* or some other allied species.

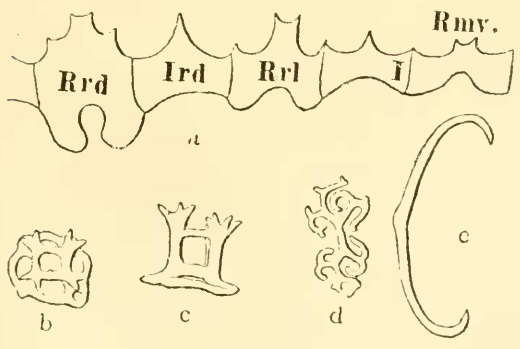
The other two lots from Torres Strait can be identified with the species. Of the three specimens examined by me, two are quite large, being about 20×10 cm. even in their present contracted state. The third specimen is much smaller, being 10×4.5 cm. In alcohol, the color of the larger specimens is uniformly light brown; the small specimen is also of that color, but shows on the dorsal surface a large patch of a darker shade of brown.

In all the specimens, papillæ raised on comparatively small warts are scattered irregularly over the dorsal surface, in the interambulacral as well as the ambulacral regions. In the ventrum,

numerous pedicels are in three distinct zones, the middle zone being, in the large specimens twice as broad, and in the small specimen about as broad, as the lateral zone.

In one of the large specimens: Polian vesicle one, pear-shaped, several cm. long, and situated on the left ventral interradius of the circular canal. In the small specimen, Polian vesicles are four in number, two being large and two small. Stone-canal one, attached to the mesentery, much meandering. The madreporic body in the usual position in the opening of the mesentery opposite the middorsal interradialia of the calcareous ring. Calcareous ring oblique, being highest and stoutest in the middorsal line and gradually narrowing toward the midventral line (textfig. 32*a*). Radialia four-pointed, interradialia one-pointed. The notch on the posterior edge of radialia is shallowest in the midventral one and gradually becomes deeper in the more dorsal ones, owing to the more pronounced posterior prolongations of these latter.

Calcareous deposits:—(i) Slender tables of only one kind, about 0.036 mm. high, with disk measuring about as much in diameter (*b*, *c*). The latter has mostly four central holes and four interradial corner holes, or at the most only a peripheral circle of small holes. Spire with one transverse beam, ending in twelve or more teeth which have a tendency



Textfig. 32.

Stichopus variegatus: *a*—Calcareous ring; *b*, *c*—Tables; *d*—Rosette; *e*—C-shaped body. (*b*—*e* × 400). I—Right ventral interradialia; Ird—Right dorsal interradialia; Rmv—Midventral radialia; Rrd—Right dorsal radialia; Rrl—Right lateral radialia.

to incline outward and look like a stag's horn. (ii) C-shaped bodies in a layer below the tables (*c*). Size various, 0.08—0.125 mm. (iii) Rosettes much smaller than C-shaped bodies, numerous, mixed with the latter; size 0.015—0.032 mm. or more (*d*). These rosettes seem to be different from C-shaped bodies and not to be a combination of them. In the younger specimen (No. 1264) rosettes seem more elaborate.

Locality :—Kosseir (LAMPERT '85); Zanzibar (LUDWIG '87, LAMPERT '96, LUDWIG '99); Mauritius (HAACKE '80, LUDWIG '83); Ceylon (LUDWIG '87*b*); Andaman Is. (BELL '87); Bay of Bengal (BELL '88); Indian Ocean (LUDWIG '82) Sunda Is. (KOEHLER '95); Bay of Batavia (SLUITER '87, '95); Pulo Edam (LUDWIG '88); Noordwachter Eiland (LUDWIG '88); Lucipara I. (SLUITER : 01); Pulu-Passi-Tanette (SLUITER : 01); East Timor (SLUITER : 01); Saleyer I. (SLUITER : 01); Saleh Bay (SLUITER : 01); Roma (SLUITER : 01); Pepela Bay (SLUITER : 01); Pidjot Bay, Lombok (SLUITER : 01); Kabaena I. (SLUITER : 01); Kur (SLUITER : 01); Atjatuning (SLUITER : 01); Elat (SLUITER : 01); Lumu-Lumu (SLUITER : 01); Waru Bay (SLUITER : 01); Waingapu (SLUITER : 01); Sarasa (SLUITER : 01); Timor (LUDWIG '82); Amboina (LUDWIG '88, SLUITER '94, '95, : 01); Cebu (LAMPERT '85, THÉEL '86); Philippines (SEMPER '67—8); Pacific Ocean (THÉEL '86); Bay of Segar, M'Cluer Gulf (LAMPERT '89); New Ireland (LAMPERT '89); Port Molle, Queensland (BELL '84); Fiji (THÉEL '86); Samoa (SEMPER '67—8); Torres Strait; Ogasawara Is.; Kōzushima, off Izu.

Family II. ELPIDIIDAE.

Subfamily I. Deimatinæ.

Genus **Lætmogone** Théel 1879.

Tentacles 15 (20 after Théel, Ludwig), rather large, not retractile. The lateral ambulacra of the ventral surface with very large pedicels disposed in a single row, all along each side of that surface. The odd ambulacrum naked. The dorsal surface with extremely elongated, flexible, non-retractile processes, disposed in a single row all along each of its ambulacra. Integument with numerous wheels, and besides these deposits spicula or cruciform bodies.

42. *Lætmogone neglecta*, sp. n.

(Pl. V., fig. 45; textfig. 33).

Specimens examined :—

Sci. Coll., Spec. No.	No. of individuals	Preservation	Locality	Depth in *hiro*	Collector	Date
1507	1	Alc.	Outside Oxinosé. Iwado-line, Sagami Sea.	300	Aoki	Nov. 14, '98.
1519	1	„	„	350	„	Feb. 17. '96?
1543	1	„	Honba, Sagami Sea.	400	„	Mar 7. '97?

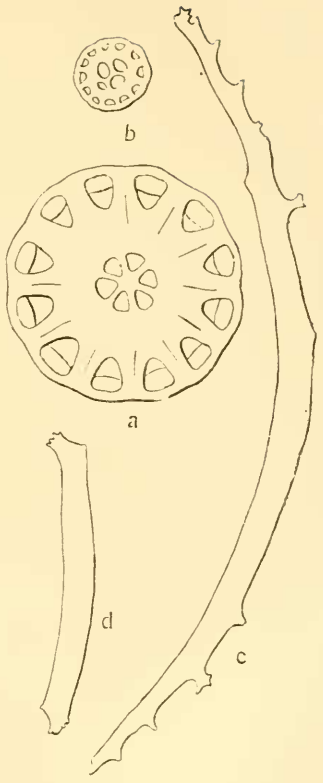
Description :—The prominent external characteristics of this species are its comparatively small size, the unusually large number of lateral pedicels, and the comparatively small number

of dorsal papillæ. In the first specimen, length 6.2 cm., breadth 1.6 cm., pedicels on each side 47—48 in number, and dorsal papillæ 18—20; in the second, length 4 cm., breadth 0.9 cm., pedicels 31—32, and dorsal papillæ 12—15. Owing to the small size of the animal and the large number of the lateral pedicels, the latter become necessarily smaller than is generally the case in the species of *Lætmogone* or *Ilyodæmon*, and appear crowded; in fact, some parts of the row appear double or at least alternately double. The diameter of the dorsal papillæ is about the same as that of the lateral pedicels.

The tentacles number 15 and are relatively large. In one specimen their tips are deep violet; in another, yellowish. The tentacular disk, in the center of which the mouth is situated, is obliquely situated so that the dorsal surface is considerably longer than the ventral surface, and the mouth faces decidedly ventrally.

The calcareous deposits are characteristic: they are large wheels, small wheels, and rods. (i) Large wheels are confined almost exclusively to the dorsal perisome, which has besides these, at the most only a few small wheels scattered far between. The large wheels have almost without exception twelve spokes, and six unequal central holes (textfig. 33*a*). Their sizes are variable, the largest being about 0.18 mm. and the smallest 0.08 mm. in diameter. There are all intermediate stages. (ii) Small wheels are found in the ventral perisome, the dorsal papillæ, and lateral pedicels. These have, also almost invariably, twelve spokes; but the central holes are as invariably four in number (*b*) and about 0.04 mm. in diameter. At the same time there are some which may be said to be between the large and the small wheels, and may be called middle-sized: thus, in Spec. No. 1519 there are

found wheels of 0.068 mm. diameter, with thirteen spokes and five central holes; in another specimen were noted wheels of 0.08 mm. diameter, with twelve spokes and four central holes. When the various parts of a small wheel are slender, it approaches the wheel-like plate seen in *Pannychia*. (iii) Rods are found scattered abundantly in the ventral perisome in a layer deeper than that of the wheels (*d*). They are mostly straight, with some irregular teeth at the ends. Their sizes are anywhere between 0.1 mm. and 0.18 mm. Supporting rods and end-plates are found only in the ventral pedicels. The former are arcuate, with some irregular teeth, about 0.3 mm. or more in length (*c*). The dorsal perisome possesses large wheels almost exclusively. Small wheels are few and far between. The ventral perisome encloses both rods and small wheels, which fact constitutes the great peculiarity of this species. The rods are in a layer deeper than the wheels. Seen in surface view, both are equally abundant. Dorsal papillæ have almost exclusively small wheels. No supporting rods, nor end-plates. Ventral lateral pedicels have small wheels and supporting rods. Besides these, there are well-developed end-plates. The supporting rods are numerous and are present throughout the length of the pedicels.



Textfig. 33.

Lutmogone neglecta: *a*—Large wheel of dorsum; *b*—Small wheel of ventrum; *c*—Supporting rod of pedicel; *d*—Rod of ventral perisome. (× 200).

Remarks :—This species is very near *L. wyville-thomsoni* THÉEL. In fact, the specimen from Japan placed by THÉEL in that species, I surmise, belongs to the present species. THÉEL himself remarks : "The individual from Station 232 was in such an incomplete state that no close examination is possible; it is only 25 mm. long and has thirteen developed tentacles and rudiments of a fourteenth ; it is most probable that this form is a distinct species from *L. wyville-thomsoni*, and this seems still more likely on considering the nature of the sea-bottom and the comparatively inconsiderable depth where the animal was found living" (1882, pp. 77—8). The chief reasons for separating the present species from *L. wyville-thomsoni* are : (1) its small size and general configuration, (2) the large number of lateral pedicels in comparison with the size of the animal, (3) the absolute smallness of the pedicels, (4) the number of spokes in large and small wheels, and (5) the geographical distribution, all the specimens of *L. wyville-thomsoni* being from the Antarctic Ocean, with the exception of the doubtful specimen above referred to from Japan, which counts for something in separating the species.

One of the animals shows protruded through a ruptured place in the dorsal perisome, a well-developed sexual organ, so that the animal must be mature.

43. *Lætmogone parva*, sp. n.

(Pl. V., figs. 46—47 ; textfig. 34).

Specimens examined :—

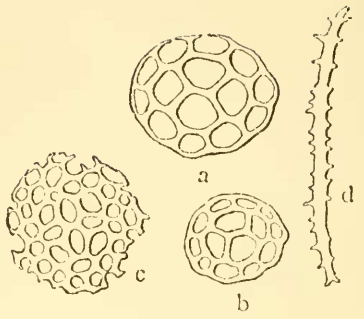
Sci. Coll., Spec. No.	No. of individuals	Preservation	Locality	Depth in *hiro*	Collector	Date
1493	2	Alc.	Numa, Uraga Channel.	350	Mitsukuri & Aoki	Aug. 9, '03.

Sci. Coll., Spec. No.	No. of individuals	Preservation	Locality	Depth in *hiro*	Collector	Date
1494	2	Glycerine mixture	North side Uraga Channel, Takeyama in line with Amezaki.	230	Mitsukuri & Aoki	Aug. 27, '03.
1495	1	„	Numa, Uraga Channel, Matsuwa Light-house-line, Mera barely out or not.	330	„	Aug. 22, '03.
1496	2	„	Numa, Uraga Channel, Matsuwa Light-house-line, Mera out or not.	330	„	„

Description:—Tentacles 15 (in one specimen only 10, in another 16). One specimen measured when fresh was 3 cm. long and 1 cm. broad. Dorsum vaulted, ventrum flat. The perisome is colorless, the tentacles are brownish, and the viscera have in general the same color, but are in some parts tinged with green. Each of the dorsal ambulacra has a row of papillæ 11 to 17 in number. The pedicels belonging to the lateral ambulacra are very numerous and slender. They go around the anterior end of the body, and do not seem to be very long. They form, at least in the middle of the body, a double alternate row, but in the smallest specimens they are in a single row. The median ventral ambulacrum is devoid of any appendage.

Calcareous deposits are not very numerous. Subjected to a rigorous search, the deposits could be discovered only in the dorsal papillæ, lateral pedicels, and on the tips of the tentacles. I can discover no large wheels such as are found in other species of *Lætmogone*. The deposits that are found on the papillæ and pedicels are small wheel-shaped plates and bent supporting rods. Small wheel-shaped plates are very much like those described under the same name by THÉEL in *Pannychia moseleyi*, or the "Gitterplättchen" described by LUDWIG in *Lætmophasma fecundum*. They are most distinctly wheel-like in the dorsal papillæ. There are four primary openings, around which there is a circle of

smaller holes typically ten in number. Moreover they are vaulted with the center highest. Those in the dorsal papillæ are 0.035—0.045 mm. in diameter (textfig. 34*b*). Sometimes they are oval, being slightly longer in one diameter than in the one at right angles to it. In the ventral pedicels, there are similar wheel-like plates, but most frequently there is a tendency to produce a second circle of small openings. Many have several circles of holes (*c*). The ventral plates are all much larger, 0.06—0.075 mm. in diameter (*a*). There are irregular, bent, thorny supporting rods in the wall of the pedicels and the papillæ (*d*); well-developed end-plates in the pedicels; and much curved rods in the tips of the tentacles, very much like those in *Lætmogone selenkai*.



Textfig. 34.

Lætmogone parva: *a*—Wheel-like plate of dorsal papilla; *b*—Same of pedicel; *c*—Complex plate of pedicel; *d*—Supporting rod of pedicel. (×240).

Remarks:—The specimens in alcohol measured respectively 2.8×0.45 mm. and 1.9×0.3 mm. They are, I believe, adults; for, in one specimen (No. 1496) not larger than the three mentioned there are to be seen some eggs which have burst out at the dorsal median line in front.

Although I am unable to make out some anatomical details such as the calcareous ring, the presence or absence of the tentacular ampullæ, or the number of genital organs, I do not think there can be much doubt that this species belongs to the subfamily Deimatinæ, and to the genus *Lætmogone*. This species is very clearly distinguishable from others of *Lætmogone* by its calcareous

spicules and their scarcity.

44. *Lætmogone selenkai*, sp. n.

(Pl. V., figs. 48—51 ; textfig. 35).

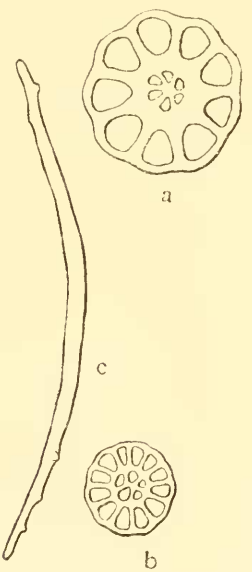
Specimens examined :—

Sci. Coll., Spec. No.	No. of individuals	Preservation	Locality	Depth in *hiro*	Collector	Date
1487	9	Glycerine mixture	North side Uraga Channel, between Matsuwa Light-house-line and Amezaki line.	100	Mitsukuri & Aoki	Aug. 24, '03.
1488	6	„	North side Uraga Channel, Amezaki in line with Takeyama.	150	„	Aug. 27, '03.
1489	2	„	Uraga Channel, off Shitaura, nearer the Bōshū side.	150	„	Aug. 17, '03.
1490	1	„	Numa, Uraga Channel, Matsuwa Light-house-line with Mera just out or not.	330	„	Aug. 22, '03.
1491	1	„	„	330	„	„
1492	1	„	„	330	„	„

Description :—Size of the largest measured, 4.7×0.8 cm. ; the smallest 2.1×0.6 cm. The perisome is entirely transparent and without any coloration : the colors seen in the animal being due entirely to those of the viscera seen through the perisome and to the crimson pith of the dorsal papillæ. Mouth faces somewhat ventrad. Tentacles 15, with the crown in life light yellow and with carmine-colored spots around its edge. The dorsum vaulted, the ventrum flat. The ventral odd ambulacrum entirely naked. Pedicels on the lateral ambulacra unusually slender (2—3 mm. long) and numerous (25—63 on each side), mostly in a single row. Papillæ on the dorsal ambulacra in a single row, less numerous and broader than those of the lateral

pedicels (10—34 in number on each side). Polian vesicle one, not colored. Genital opening on a papilla on the median dorsal line. Stone-canal opening by means of 5—8 pore-canals near the genital opening.

Calcareous deposits : With a hand-lens, one can recognize in the fresh state numerous white spots scattered everywhere in the perisome on the dorsal as well as the ventral surface ; these are wheels. The large wheels have six or rarely five unequal holes in the center, and nine or ten (rarely eight) spokes (textfig. 35*a*). The diameter measured 0.132—0.096 mm. in those near the anterior end of the dorsal surface, and 0.060—0.075 mm. in those in the pedicels and the ventral perisome. Besides these, there are smaller wheels with four central holes and twelve or thirteen spokes (*b*), the diameter measuring 0.032—0.046 mm. In the pedicels, there are, besides these wheels, supporting rods about 0.2 mm. long, which are spiny near the ends and somewhat bent (*c*). They are most crowded near the ends of the pedicels. The pedicels have also well-developed end-plates. In the tentacles, bent or nearly straight irregular calcareous rods are found near the tips of the branches.



Textfig. 35.

Latmogone selenkai : *a*—Large wheel ; *b*—Small wheel ; *c*—Supporting rod of pedicel. (×210).

Remarks :—The specimens are mature as the sexual organs were ripe at the time of capture. The great peculiarity of this species is its small size and its numerous lateral pedicels, which are more slender and more numerous than the dorsal papillæ. If emphasis be laid

on the fact that the pedicels in preserved specimens are in more than one row in some parts of the body length, this might be put in the genus *Ilyodæmon*, but as the dorsal papillæ are so distinctly in one row, I have placed it in *Lætmogone*. I agree with previous writers, like SLUITER, in thinking that the distinction can not be maintained between *Ilyodæmon* and *Lætmogone;* and this species offers a strong argument in support of that view.

The species nearest to the present one is *Ilyodæmon fimbriatus* SLUITER, but there are some important points of difference which oblige us to separate the two species: (1) The size is very different; in *I. fimbriatus*, the smallest specimen measured 8×2.5 cm., while in the present species the largest examined is 4.7×0.8 cm. The small size, as I have stated above, is not due to the immaturity of the specimens. Hence we must believe that there is a considerable difference in the size of the two species. (2) In *I. fimbriatus*, the dorsum is said to be hardly more vaulted than the ventrum. In the new species, the dorsum is decidedly vaulted, while the ventrum is flat. (3) In *I. fimbriatus*, the papillæ are said to be smaller than the pedicels, as in so many other species of *Lætmogone* and *Ilyodæmon*. In *L. selenkai*, the papillæ are broader than the pedicels. (4) In *I. fimbriatus*, each of the two dorsal radii has a double row of papillæ. In *L. selenkai*, there is only one row of papillæ on each ambulacrum, a fact which induced me to place it in the genus *Lætmogone*. (5) In *I. fimbriatus*, dorsum and ventrum are "hell-violett" while pedicels and papillæ are somewhat darker rose-violet; the end-disks of both pedicels and tentacles, are said to be dark violet. In *L. selenkai*, the perisome is transparent and colorless; the end-disks of the pedicels are likewise colorless, but those of the

tentacles are light yellow fringed with crimson spots. (6) The calcareous bodies are very much alike in the two species. But in *I. fimbriatus*, the large wheels are about 0.175 mm. in diameter. while in the present species, they are usually smaller, none being larger than 0.132 mm. and some as small as 0.06 mm. In *I. fimbriatus* small wheels are 0.05 mm. in diameter, have usually ten spokes, and always four holes in the center. In my species, they are not larger than 0.046 mm. and may be as small as 0.032 mm. and have usually twelve spokes. (7) Polian vesicle is colorless in my species, so far as can be made out from a preserved specimen which has not lost its color. It is said to be violet in *I. fimbriatus*.

All these points oblige us to establish the species as a new one. I have pleasure in naming it for the late Prof. Emil Selenka whose work marked an epoch in the study of Holothurioidea.

45. *Lætmogone violacea* Théel.

(Pl. VI., figs. 52—54; textfig. 36).

Lætmogone violacea Théel 1882*b*, p. 78, Pl. XIII., XXXVI., figs. 20—24, Pl. XLII., fig. 2.—Théel 1879, p. 11, Pl. I., figs. 14*a-d*.—Lampert 1885, p. 196.—Ludwig 1889—'92, p. 338.—Perrier 1896, p. 900.—Perrier 1900, p. 116.—Sluiter 1901*b*, p. 62.—Perrier 1902, p. 390.

Cryodora spongiosa Théel 1879, p. 9.

Lætmogone spongiosa Théel 1882*b*, p. 80, Pl. XIV.,—Lampert 1885, p. 196.—Ludwig 1889—92, p. 338.—Mitsukuri 1896, p. 409.

Lætmogone jourdainii Petit 1885, p. 9.—Ludwig 1889—'92, p. 338.

Lætmogone bronguiarti Perrier 1891, p. 337, fig. 241.—Ludwig 1889—'92, p. 338.

Specimens examined :—

Sci. Coll., Spec. No.	No. of individuals	Locality	Depth in *hiro*	Collector	Date
1497	2	Off Inatori, Izu, Sagami Sea.	400	Ijima	July 25, '94.
1498	1	Inside Okinosé, Sengenzuka-line, Sagami Sea.	400	Aoki	Dec. 2—4, '96.
1499	1	,,	350	,,	Jan. 20, '96.
1500	4	Homba, Sagami Sea.	400	,,	Mar. 8,— May 2, '96.
1503	1	,,	400	,,	Dec. 17, '94.
1501	4	Sagami Sea		,,	
1502	2	Outside Okinosé, Iwado-line, Sagami Sea.	400	,,	Jan. 19, '97.
1504	2	,,	300—350	,,	Dec. 2, ?
1505	7	Outside Okinosé, Iwado-line, Aoyama out, Sagami Sea.	400	,,	Feb., '95.
1506	2	Homba, Sagami Sea.	500	,,	May 13, ?
1508	3	Outside Okinosé, Iwado-line, Sagami Sea.	400	,,	Apr. 17, '94.
1509	1	Yodomi, Sagami Sea.	400	,,	Mar. 16, ?
1510	1	Outside Okinosé, Iwado-line, Sagami Sea.	350	,,	Feb. 14, '97.
1513	1	Okinosé, Sagami Sea.	400	,,	Apr. 21, '97.
1514	2	Sagami Sea		,,	
1517	4	Outside Okinosé, Sagami Sea.	400	,,	Feb. 25, '04.
1520	1	Outside Okinosé, Iwado-line, Sagami Sea.	300	,,	Nov. 14, '98.
1521	1	Sagami Sea (Lat. 35° 8′ 10″ N., Long. 139° 32′ E.)	300	Owston	Aug. 8, '03.
1553	1	Outside Okinosé, Iwado-line, Sagami Sea.	400	Aoki	Mar. 13, '99.

Description :—"Body elongated, about twice and a half as long as the greatest breadth. Mouth anterior, subventral. Anus posterior, terminal, slightly dorsal. Tentacles of almost equal size; their terminal part rather large, almost discoidal, destitute of visible processes. Pedicels eleven along the left side of the ventral surface, and twelve along the right, rather long and large; the posterior pairs small. Processes of the dorsal surface very slender and flexible, in one individual twenty, in another twenty-three along each of the ambulacra; the largest process about as long as the greatest breadth of the body; a rather short genital process placed in the medio-dorsal line, a little behind the tentacles. Integument very thin and rough, with four sorts of numerous calcareous deposits: scattered spicula; spinose bodies, cruciform or in the form of an X, with the four arms curved; large wheels frequently with eight spokes; and small wheels, sometimes with thirteen spokes. Both sorts of wheels resembling those of *Lætmogone wyville-thomsoni* (i.e., concave, the felly being directed outwards, not on the same plane as the nave; the wheels have somewhat the form of a crown); between the large and small wheels there are many forms, varying much in size and shape. Colour in alcohol, grey violet. Ends of the tentacles light yellowish-brown. Length about 90 mm. Breadth about 35 mm." (Théel 1882, p. 78).

Remarks :—Next to *Ilyodæmon ijimai*, this is the commonest holothurian in the deeper parts of the Sagami Sea. It seems to occur in all parts of that sea in depths greater than 250 fathoms.

The measurements, and the number of pedicels and processes in some of my specimens, are as in the following table:

Specimen Number	Body-length in mm.	Body-breadth in mm.	Length × $\frac{}{\text{breadth}^2}$	No. of left lateral pedicels	No. of right lateral pedicels	No. of left dorsal papillæ	No. of right dorsal papillæ
1513	18	8	1152	12	12	9	7
1510	22	10	2200	11	11(?)	12	12
1521	23	11	2783	14	13	11	11
1517*a*	29	15	6525	13	13	15	15
1504*a*	54	19	19494	15	13	19	19
1501*a*	45	23	23805	14	15	22	23
1501*b*	57	21	25137	15	13	16	17
1497*a*	67	21	29547	15	14	18	19
1517*b*	55	25	34375	14	13	19	19
1503	79	21	34839	15	13	22	21
1504*b*	63	24	36288	13	13	23	23
1498	72	23	38088	14	14	18	17
1501*d*	68	24	39168	13	15	20	20
1502*a*	82	25	51250	16	15	24	23
1499	75	28	58800	13	13	23	25
1517*c*	66	30	59400	14	15	28	25
1501*c*	80	28	62720	13	14	25	25
1497*b*	87	28	68208	13	13	13	16
1502*b*	96	28	75264	13	13	21	21
1506*b*	115	44	222640	14	13	27	26
1506*a*	103	47	227527	14	14	23	22

In this table, several interesting facts appear.

1. The length of the body is commonly a little over twice its breadth. In some cases, it is three times as long or even longer.

2. The number of lateral pedicels in larger individuals is less than the number of the dorsal papillæ.

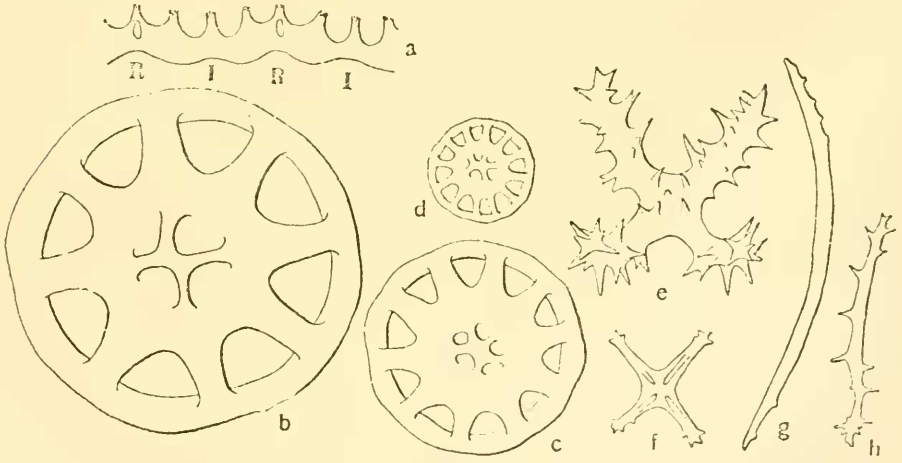
3. The number of lateral pedicels does not increase with the size of the individuals. On the other hand, an examination of various individuals shows that the lateral pedicels grow larger in absolute size in older individuals.

4. The number of dorsal papillæ increases with the size of the individuals. That is, older individuals have a larger number of papillæ than younger individuals. On the other hand, the absolute size of the papillæ does not increase as much as in the case of lateral pedicels.

Dorsal papillæ are slender and conical, and in the best preserved individuals are of a considerable length, viz., 36—40 mm. Some of the most anterior ones are in a transverse row. Each longitudinal series may be said to be in a single line and internal dissection shows that they all arise on the median side of each dorsal abulacrum. At its origin, each papilla has a not very large vesicle freely projecting into the body-cavity and violet in color. Lateral pedicels are on each side in a strictly single row. Dissection shows that each pedicel has in the substance of the ventral perisome a cavity divided into three compartments, which however freely communicate with one another, the apparent partitions being only ridges projecting from the roof of the cavity. These cavities show themselves from the outside in ventral view of the animal. Tentacles 15 in number, large, disk-shaped, not contractile.

Calcareous ring is well developed (textfig. 36*a*). When looked at from the outside, it looks simply like a plain ring with some indentations, but when it is pulled outward so as to show the inside a little, processes become visible. Polian vesicle one, on the left ventral interradius of the circular canal. Genital organs two, bushy, one on each side of the dorsal mesentery. Genital papilla distinct in the median dorsal line. The stone-canal opens with several openings near the base of the genital papilla.

Calcareous deposits are as pointed out by THÉEL, comprising large wheels, small wheels, cruciform bodies, and spinose spicules. Large wheels are largest in dorsal papillæ, 0.180—0.220 mm. in diameter, with eight or rarely nine spokes and four central holes (*b*); those in lateral pedicels, 0.120—0.164 mm. In dorsal and



Textfig. 36.

Latmogone violacea: *a*—Calcareous ring; *b*—Large wheel of dorsal papilla; *c*—Middle-sized wheel of dorsal perisome; *d*—Small wheel of dorsal papilla; *e*—Spinous spicule of dorsal perisome; *f*—Cruciform body of ventral perisome; *g*—Supporting rod of dorsal papilla; *h*—Spinous rod from genital tubes. (*b*—*h* × 200). I—Interradialia; R—Radialia.

ventral perisome, large wheels are few and scattered, cruciform bodies being most numerous. The large wheels are relatively

small or middling in size, 0.08—0.13 mm. in diameter, with 8—10 spokes and 3—5 central holes (*c*). Small wheels on the dorsal papillæ and lateral pedicels have 10—15 spokes and 4—5 central holes, the diameter measuring 0.052—0.108 mm. (*d*). Cruciform bodies are found in the dorsal and ventral perisome and are four-, three-, or sometimes five-radiated, with several irregular teeth on the ends of the arms (*f*). They measure 0.18—0.14 mm. in diameter. Spinose spicules (*e*) are found only in the dorsal and ventral perisome but none in the appendages. They vary from 0.15 to 0.20 mm. in length. End-plates and supporting rods (*g*) are found at the ends of the lateral pedicels. No calcareous bodies are found in the cloacal wall or peritoneum. In the genital tubes there are slender bent spicules with teeth (*h*).

On the outer surface of this animal, a hydroid colony with an extensive network of hydrorhiza with hydroid polyps arising from the nodes was sometimes observed.

Locality :—"Challenger" Stat. 164 and 235 (THÉEL '82); "Knight Errant" Stat. 4 (between Faroë Is. and Scotland) (THÉEL '82); "Siboga" Stat. 314 and 178 (SLUITER : 01); "Talisman" Dr. 13, 31, 45, 48, 49, 84, 85, 93 and 121 (PERRIER : 02); Sagami Sea.

Genus **Ilyodæmon** THÉEL 1879.

In the description given of *I. ijimai* (MITSUKURI 1897*b*, p. 133), I emphasized the fact that in that new species dichotomously branched bodies are wholly lacking; hence the last part of the description given by THÉEL (1882) should read "Integument with numerous wheels, sometimes also with dichotomously branched bodies." After a closer study, I am inclined to make some more

additions or emendations as to other parts. (1) Lateral pedicels are said by Théel to be "apparently disposed in a double row all along each side of that surface." I am inclined to think that the lateral pedicels are in one series along the side of the body, and that they appear double only as the result of contraction. (2) The "crowded series of dorsal processes" are, in *I. ijimai* at least, always in four rows on the dorsal surface or in two rows in each longitudinal half. That is, on the sides of each dorsal ambulacrum there is an alternating double series of slender dorsal papillæ, and, when they are looked at from the inside, the ambulacral vesicles of these papillæ form one series on each side of the longitudinal muscle. As emended, the definition of the genus should be as follows:—

Tentacles 15, rather large and non-retractile. The lateral ambulacra of the ventral surface with large pedicels, arranged in a single series along each side of the body, often appearing in alcohol specimens as if they were disposed in a double alternating row. The odd ambulacrum naked. The dorsal surface with a series of very numerous retractile, slender, rather long processes, disposed generally in two alternating rows on the sides of each dorsal ambulacrum, but often appearing crowded on account of contraction. Internally, a series of ambulacral vesicles corresponding to each double row, is seen on each side of the longitudinal vessel. Integument with numerous wheels, sometimes also with dichotomously branched bodies.

Sluiter (1901*b*, p. 66) expresses doubt as to the possibility of keeping *Lætmogone* and *Ilyodæmon* separate. He says "Ich glaube dass es in der Zukunft kaum möglich sein wird, die beiden Genera *Lætmogone* und *Ilyodæmon* nebeneinander zu behalten." I was at first inclined to accept this view, but further study has

convinced me that, for the present at least, the two genera should be kept apart. When a dorsal ambulacrum is looked at from the inside, there is in *Lætmogone* only one series of ambulacral vesicles on the outer side of the said ambulacrum; while in *Ilyodæmon* there are two series of these vesicles, one on both the outer and the inner sides of the ambulacrum.

46. *Ilyodæmon ijimai* MITSUKURI.

(Pl. VI., fig. 55; textfig. 37).

Ilyodæmon ijimai MITSUKURI 1897*b*, pp. 133—5.

Specimens examined :—

Sci. Coll., Spec. No.	No. of individuals	Preservation	Locality	Depth in *hiro*	Collector	Date
1515	1	Alc.	Outside Okinsé, Iwadoline, Sagami Sea.	330—340	Aoki	May, '95.
1516	1	„	Sagami Sea		„	
1523	3	„	„		„	Spring, '96.
1524	5	„	Outside Okinosé, Iwadoline, Sagami Sea.	350—400	„	Feb. 8—9, '96.
1525	3	„	„	350	„	May 31, '97.
1526	2	„	„	350	„	
1527	3	„	Inside Okinosé, Enaline, Sagami Sea.	350	„	Jan., '96.
1528	5	„	Inside Okinosé, Sengenzuka-line, Sagami Sea.	400	„	Dec. 2—4, '96.
1529	1	„	Homba, Sagami Sea.	400	Ijima & Aoki	Dec. 17, '94.
1530	1	Glycerine mixture	Outside Okinosé Sagami Sea.	400	Aoki	Feb. 25, '04.
1531	2	Alc.	Outside Okinosé, Iwadoline, Aoyama in Yawata out, Sagami Sea.	400	„	Feb. 2, '95.

Sci. Coll., Spec. No.	No. of individuals	Preservation	Locality	Depth in *hiro*	Collector	Date
1532	8	Alc.	Sagami Sea		Aoki	Nov.—Dec., '96.
1533	1	,,	,,		,,	Spring, '96.
1534	1	,,	Inside Okinosé, Sagami Sea.		,,	Nov., '95.
1535	8	,,	Outside Okinosé, Iwado- and Ito-lines, Sagami Sea.	300—350	,,	Feb. 5—27, ?
1536	5	,,	Outside Okinosé, Iwado-line, Sagami Sea.	350	,,	Mar. 6, ?
1537	1	For-malin	Okinosé, Sagami Sea.	350	,,	Dec. 18, '00.
1538	1	Alc.	Meranosé, Sagami Sea.	400	,,	Mar. 7, '96.
1539	1	,,	Outside Okinosé, Sagami Sea.	550	,,	Feb. 2, '96.
1540	6	,,	,,	350	,,	
1541	3	,,	Numa, Matsuwa Light-house-line, Sagami Sea.	350—400	,,	Jan. 25, '97.
1542	3	,,	Homba, Sagami Sea.	400	,,	Mar. 7, '97.
1544	1	,,	,,	350—400	,,	Dec. 7, '94.
1545	2	,,	Yodomi, Sagami Sea.	400	,,	Mar. 15, ?
1546	3	,,	Outside Okinosé, Iwado-line, Sagami Sea.	400	,,	Apr. 17, '95.
1547	3	,,	Mochiyama, Sagami Sea.	350	,,	Mar. 9, ?
1548	1	,,	Sagami Sea		,,	
1549	1	,,	Outside Okinosé, Iwado-line, Sagami Sea.	350—400	,,	Feb. 14, '97.
1550	2	,,	Inside Okinosé, Sengen-zuka-line, Sagami Sea.	350	,,	Jan. 20, '96.
1551	1	,,	Yodomi, Sagami Sea.	400	,,	Mar. 16, ?

Sci. Coll., Spec. No.	No. of individuals	Preservation	Locality	Depth in *hiro*	Collector	Date
1552	1	Formalin	Mochiyama, Sagami Sea.	400	Aoki	Aug. 10, '97.
1554	1	,,	Outside Okinosé, Iwadoline, Sagami Sea.	400	,,	Mar. 19, '99.
1555	1	,,	Okinosé, Sagami Sea.	350	,,	Dec. 18, '00.
1556	1	,,	Inside Okinosé, Sengenzuka-line, Sagami Sea.	400	,,	Dec. 10, '99.
1557	1	,,	Outside Okinosé, Iwadoline, Sagami Sea.	400	,,	May 12, '99.
1558	1	Alc.	Yodomi, Sagami Sea.	350	,,	Dec. 18, ?
1559	1	,,	Outside Okinosé, Iwadoline, Sagami Sea.	400	,,	Jan. 19, '97.
1560	4	,,	Off Mera, Gokeba, Sagami Sea.	400	,,	Apr. 20—31, '95.
1561	1	,,	Homba, Sagami Sea.	350—400	,,	Dec. 7, '95.
1562	2	,,	,,	400	,,	May 2, '96.
1563	1	,,	Outside Okinosé, Aoyama in Yawata out, Sagami Sea.	400	,,	Feb. 2, ?

Description :—Body elongated, of almost equal breadth throughout, the length of largest alcoholic specimens being 120—160 mm. and the width 35—40 mm., about 3—4 times as long as broad. Mouth anterior, subventral. Anus posterior, subdorsal. Tentacles 15, with large circular discoidal ends ; on the whole, the ventral tentacles smaller than the dorsal. The odd ventral ambulacrum naked. Pedicels of each lateral ambulacrum 22—25 ; the alternate arrangement of pedicels in the inner and outer rows of each ambulacrum very obvious in some specimens, but hardly recognizable in others, the difference being probably due to the degree of contraction in alcoholic specimens. Processes of each of the dorsal ambulacra very numerous, conical, rather short,

the longest about one-third of the width of the body, and in about four rows, of which the inner two are sometimes distinctly separated by a space from the outer two. Back naked in the median dorsal interambulacrum, with the exception of the genital process in the anterior part. Integument soft and pliable, sometimes thin, sometimes thicker and spongy (the difference being due to the state of preservation); colorless, more or less translucent, most so in the fresh state; internal organs (especially the light-colored ones like the genital organs) visible from the surface. Color in alcohol, whitish grey without any white spots; in the fresh state, a beautiful light violet, with deeper tints on the dorsal papillæ. A rather broad straw-colored streak on each side of the dorsal surface and outside the outer series of dorsal papillæ, becoming fainter toward the front, is visible in the fresh state, but is lost in preserved specimens. Polian vesicle one, on the left ventral interradius; in one specimen 2.2 cm. long. Genital organs paired, bushy. Stone-canal opens to the exterior by a number of small openings, near the genital papilla, which is in the anterior part of the median dorsal interambulacrum. When the area of the openings is somewhat circumscribed and convex, it appears like a madreporic plate.

Calcareous deposits in the general perisome consist of two kinds of wheels: large wheels with six central rods and 9—12 spokes (textfig. 37*b*), and small ones with four central rods and usually twelve spokes (*c*). Arcuate or spindle-shaped spicules are present on the pedicels and tentacles (*d*).

Remarks:—This is by far the commonest of the holothurians found in the deeper parts of the Sagami Sea, exceeding greatly in number *Lætmogone violacea* Théel, which is next to it in abundance.

Measurements, etc., of some preserved specimens are as follows :—

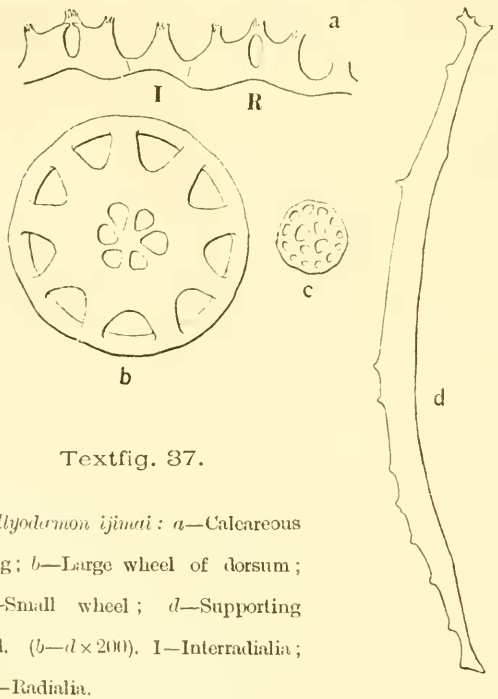
Specimen Number	Length in cm.	Breadth in cm.	Ratio of length to breadth	No. of left pedicels	No. of right pedicels	No. of papillæ of left inner series
1523*a*	10.8	4.0	2.7 : 1	23	24	
1523*b*	6.0	1.5	4 : 1	19	20	ca. 43
1516	7.5	1.5	5 : 1	23	23	ca. 58
1524*a*	15.0	3.0	5 : 1	24	24	well-extended 61
1524*b*	5.0	2.0	2.5 : 1			
1524*c*	10.5	3.0	3.5 : 1	26	22	well-extended 63
1525*a*	13.0	3.0	4.3 : 1	25	25	80
1525*b*	9.6	2.7	3.6 : 1	25	26	
1526*a*	13.0	3.5	3.7 : 1	24	25	ca. 74
1528	9.0	3.5	2.6 : 1	22	24	
1529	8.5	2.7	3.1 : 1			
1530	8.2	2.0	4 : 1	23	23	ca. 49
1535	5.4	1.6	3.3 : 1	21	21	
1537	12.0	4.0	3 : 1	24	22	ca. 83
1542	11.0	3.0	3.6 : 1	23	25	74
1558	5.3	2.1	2.5 : 1	22	23	29
1551	13.5	4.0	3.5 : 1	23	22	91

The above table shows: (1) that the length of the body is between 2.5—5 times the breadth, the seeming differences being largely due to the degree of contraction of specimens; (2) that the number of the lateral pedicels does not increase with the size of the individuals, although the larger the individuals the larger seems to be the absolute size of these pedicels; (3) that the number of dorsal papillæ increases with the size of the individuals; that is, the older the individuals, the greater the number of dorsal papillæ. Their absolute size does not however increase as much as in the case of the lateral pedicels. The last two points are as in *Lætmogone violacea*, and such seems to be the case with all similar species.

The lateral pedicels are stated by Théel to be apparently disposed in a double row all along each side of the body. The word "apparently" is very important; for an examination of a large number of specimens convinces me that in life they are in a single row, and that the double appearance is caused by contraction in preservation. Similarly, the papillæ of the dorsal surface are stated by Théel to be disposed in three or four irregular close-set rows along each of the dorsal ambulacra. In all the well-extended specimens I have examined, there are only two rows along each of the dorsal ambulacra, one on the outer and the other on the inner side of that ambulacrum. Each row has, however, its papillæ arranged in a zigzag line so that it may be described as alternately double. When the animal is contracted in killing, it is very easy for a row to appear double; in such a case there appear to be present three or four rows of papillæ on each side. That they are, however, in life in two rows is proved by the fact that even in the same animal they appear in three or four rows when contracted, and in two rows when well-

extended. Moreover, when we look at them from inside, the vesicles which are present on the inside, corresponding to each of the dorsal papillæ, are arranged in two rows, one on each side of the ambulacrum. The length of the papillæ is, in preserved specimens, 0.7—1 cm. The lacunæ in the ventral perisome, corresponding severally to each lateral pedicel and its three divisions, are similar to the structures described in *Lætmogone violacea*.

In the dorsal perisome, there are present large wheels, with small wheels only in very small proportion, if present at all; some of the former are the largest in the whole body. They have mostly nine spokes (rarely eight, ten, eleven or twelve, sometimes even sixteen) and six central holes (very rarely four, seven or eight); the diameter measures 0.06—0.255 mm., but commonly 0.10—0.18 mm. In dorsal papillæ, the basal part has large and small wheels, but toward the upper part only small ones are present. The small wheels have the margin crenate; spokes eleven or twelve, central holes four, diameter 0.030 — 0.048 mm.



Textfig. 37.

Ilyodæmon ijimai: *a*—Calcareous ring; *b*—Large wheel of dorsum; *c*—Small wheel; *d*—Supporting rod. (*b*—*d* × 200). I—Interradialia; R—Radialia.

While we may find large "large wheels" in small individuals and small "large wheels" in large individuals, there is in many cases a striking contrast in appearance be-

tween the calcareous bodies in the dorsal perisome of large and small individuals. Medium-sized individuals are intermediate between these. If the size of individuals had been measured when fresh, the gradation would be more striking.

The species is named for my colleague Prof. Dr. I. Ijima in pleasant remembrance of many uncomfortable but fruitful days spent together in fishing boats on the Sagami Sea, and in appreciation of his great services in bringing to light the treasures of these deeper parts.

Genus **Pannychia** Théel 1882.

"Tentacles 20, rather large and non-retractile. The lateral ambulacra of the ventral surface with large pedicels, disposed in a single row all along each side of that surface. The odd ambulacrum with a double row of pedicels. The dorsal surface with a crowded series of very numerous, slender processes all along each side. Integument with numerous wheels and small wheel-shaped plates." (Théel 1882, p. 88).

47. *Pannychia moseleyi* Théel.

(Textfig. 30).

Pannychia moseleyi Théel 1882*b*, p. 88, Pl. XVII., Pl. XXXII., figs. 1—13.—Lampert 1885, p. 197.—Ludwig 1889—'92, p. 337. Kishinouye 1894, pp. 146—7.—Ludwig 1894, pp. 278—9.—Sluiter 1901*b*, pp. 71—2.—Perrier 1902, p. 405.

Pannychia moseleyi var. *henrici* Ludwig 1894, p. 95, Taf. X., Fig. 1—2.

Specimens examined :—

Sci. Coll., Spec. No.	No. of individuals	Preservation	Locality	Depth in *hiro*	Collector	Date
1511	1	Alc.	Outside Okinosé, Iwado-line, Sagami Sea.	400	Aoki	Jan. 20, '97.
1512	1	„	Sagami Sea		„	
1564	1	Formalin	Outside Okinosé, Sagami Sea.	400	„	Mar. 12, '05.

Description :—Tentacles 20. Body elongated, almost cylindrical (Théel), or the dorsum vaulted and the ventrum flat (Ludwig). Mouth anterior, subventral. Anus posterior, terminal. Along each of the lateral ambulacra, a series of large pedicels variable in number (left 30, right 29, Théel ; 13—25 on each side, Ludwig ; 25 on each side, Sluiter). Along the median ventral ambulacrum a double row of smaller pedicels (55 Théel, 6—14 Ludwig, 24 Sluiter) which are more numerous in the posterior half than in the anterior (in Sluiter's specimen 18 in the posterior half and 6 in the anterior half). Numerous dorsal processes (100 Théel) form two longitudinal series, one along each side of the back, leaving a rather broad naked area between them ; each series contains several processes ranged side by side, though their arrangement in rows is imperceptible. Some of these processes seem, judging from the ambulacral cavities or vesicles, to belong to the lateral ventral ambulacra. The longest attain a length of 15—20 mm., but most of them, being minute and almost rudimentary, are only visible as lighter spots. Calcareous deposits are of two kinds : large wheels and small wheel-like plates. Large wheels are very large, 0.24 mm. in diameter, with 11—14 spokes ; the felly carries between the spokes round lobes, the number of which is the same as that of the spokes. The large nave is perforated by

a more or less round central hole, from the edge of which projects a crown constructed of four or more slightly curved arms. The central hole is covered in every case with an opercular plate through which there may open from one to several openings. Small wheel-like plates are 0.052 mm. in diameter, with about 15 holes (four in the center and eleven around the periphery). Large wheels are most numerous in the dorsal perisome and the processes; they are very few and scattered in the ventral perisome and pedicels. Besides, the dorsal perisome contains some wheel-like plates; while in the ventral perisome there are numerous small wheel-like plates and isolated large wheels (Sluiter). Supporting rods and end-plates present in pedicels. Calcareous ring rudimentary, fragile and spongy. Polian vesicle, one. Stone-canal opens to the exterior by several pores. Genital bundles, two. Size, 20 cm. long and 4 cm. broad. Color, greyish white; back, dark violet in alcohol, violet when fresh (Ludwig).

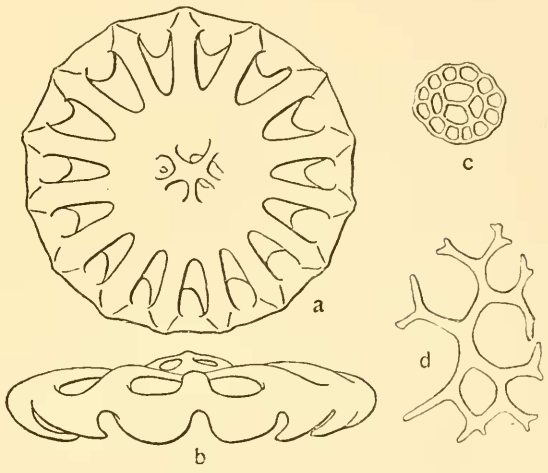
Remarks:—The specimens are considerably smaller than the "Challenger" specimens, being respectively 53 mm. × 13 mm., 33 mm. × 10 mm. and 90 mm. × 19 mm. They are at present much shrunk, and there can be no doubt that they were much longer when living: in fact Aoki makes a statement to that effect.

Tentacles 20, large, non-retractile, in some specimens decidedly yellowish. Dorsum vaulted, ventrum flat. Along each side of the body there is a series of large pedicels; in the first specimen, 17 on the left side and 19 on the right; in the second, 17 or 18 on each side; in the third, 19 on the left, 20 on the right, being crowded and smaller toward the posterior end. Along the median ventral ambulacrum, the second specimen has about 11 pedicels somewhat smaller than the lateral, and arranged in a zigzag row. Of these, about nine are in the posterior half of the

body (approaching var. *henrici* in this respect). In the first specimen no pedicel can be detected on the median ventral ambulacrum. This is probably due not to their actual absence but to the extreme shrinking which the specimen has undergone. In the third specimen, the first of the median pedicels is somewhat in front of the middle; at first there is considerable space between them, while they become crowded toward the posterior end. On each of the dorsal ambulacra, some 15 or more conical papillæ can be counted; in reality the number is probably much larger. In the first specimen there is much difference in size, some being large and others smaller, the posteriormost series being especially long. In the second specimen, they seem all about equally slender and long. In both specimens the anterior two or three are in a transverse row. In the third specimen, besides the double rows on each side there are one or two rows of small, low papillæ which seem to be given off from the ventral lateral ambulacra.

In the general perisome, large wheels and small wheel-like plates are present. In my specimens, both kinds of these deposits seem to be as numerous in the ventral perisome as in the dorsal. This is different from what was observed by Théel, who says that large wheels are most numerous in the walls of the papillæ and the dorsal perisome, while only a few of them occur on the ventral surface and in the pedicels and tentacles. In Sluiter's specimens also, numerous wheels and wheel-like plates were present in the dorsal perisome, but in the ventral perisome there were only wheel-like plates and not a single wheel. Large wheels are very characteristic (textfig. 38 *a*, *b*). The spokes are rather numerous, numbering 12—15 in my specimens, 13 and 14 being the most common numbers. Moreover, between every two spokes, there is a roundish plate on the under side, which is visible

through the intervals between the spokes. The crown in the center is usually of the triradiate type and shows generally five openings. The "Deck-platte" closes this from below, and there may be one or more—up to several—openings in this plate. The wheels in question are very large, the largest reaching 0.216 mm. in diameter. They may be as small as 0.072 mm., but such are not very numerous. In my specimens they are largest in the dorsal perisome. Small wheel-like plates have always four holes in the center, and 10—11 in the periphery (*c*). They are circular or slightly oval. In the former case, the diameter is 0.044—0.056 mm.; in the latter case, 0.056 mm. in longer diameter and 0.048 mm. in shorter diameter (in one specimen, 0.056 and 0.052 mm. respectively). In the dorsal papillæ, large wheels and wheel-like plates are present up to very near the tip; but near the tip, there are only wheel-like plates. There are no end-plates, but there exist some weak supporting rods. In the ventral pedicels, there is a large irregularly large- and small-meshed end-plate. Around and over the end-plate there are irregular X-shaped supporting rods (*d*). In the lateral walls, there occur also some spinose supporting rods. Like Ludwig I can not detect any wheel-like plate which is like Théel's fig. 7 in Pl. XXXII., nor any plate like his fig. 8 in Pl. XXXII.



Textfig. 38.

Pannychia moseleyi: *a*, *b*—Large wheels; *c*—Small wheel-like plate of dorsum; *d*—Irregular plate around the end-plate of lateral pedicel. (×200).

Locality :—" Challenger " Stat. 164, 169 (THÉEL '82); Near Ōshima I. (KISHINOUYE '94); " Albatross " Stat. 3371, 3431, 3432, 3436 (LUDWIG '94); " Siboga " Stat. 145 (SLUITER '01) ; Sagami Sea.

Subfamily 2. Elpidiinæ.

Genus **Periamma** PERRIER 1896.

The forms belonging to the family Elpidiidæ seem to be very closely allied and to pass from one to another by gradual transitions. It is therefore no wonder that its genera were not very sharply defined by its discoverer (THÉEL 1882). So long as the known forms did not increase in number, THÉEL's classification was satisfactory enough, and LAMPERT (1885) and LUDWIG (1889—'92) followed THÉEL closely. As soon however as the number of newly discovered species increased, it was evident that THÉEL's system was not entirely adequate to showing where they belonged. HEROUARD (1902) made an attempt to revise the family, but he depended altogether on the shape of the body and did not take into account the nature of the spicules, with the result that he gave an entirely new definition to some of the old generic names. PERRIER (1902) then proposed a revision of the family, which, while it is not probably the last that will be said on the subject, is a great improvement on THÉEL and HEROUARD. I therefore, for the present at least, adopt PERRIER's revision, as I have not materials enough at command to attempt one myself.

48. *Periamma kumai*,* sp. n.

(Pl. VI., figs. 56—58; textfig. 39).

Specimens examined :—

Number of individuals	Locality	Depth in *hiro*	Collector	Date
4—5	Yodomi, Yahagi-line, Mera just out, Sagami Sea.	300	Mitsukuri & Aoki	Aug. 17, '03.
More than 10	„	330	„	Aug. 20, '03.

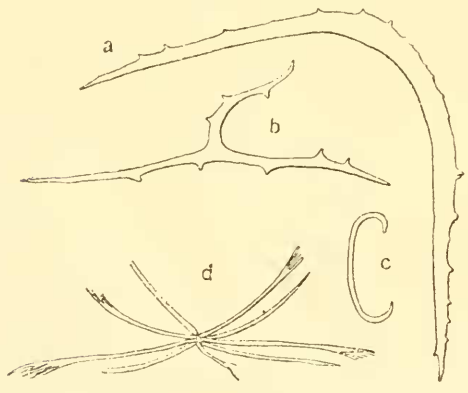
The specimens of the first set were already much macerated when brought up by the long-line and brought into the laboratory. Accordingly KUMA was sent out three days after specially to get this species. I can not but admire the skill of the collector who succeeded in getting over ten specimens on the same spot. They were in a tolerably good condition, enabling me to make a sketch in the fresh condition and make examinations otherwise. They were most delicate creatures, and in spite of the great care taken to preserve them (in a mixture of sea-water, alcohol and glycerine), they were much macerated, especially during their transportation to Tokyo.

The general configuration of the specimens puts them at once in the family Elpidiidæ. There is a sharp demarcation between the dorsal and the ventral surfaces. The former is vaulted, the latter is flat. There is no appendage in the posterior part, but at the anterior end there is a large four-lobed transverse appendage formed by the union of four papillæ into a common

* Named for the collector KUMA AOKI.

"palmure." Just posterior to this, there is a pair of small pointed conical appendages. In front of the "palmure" the body bends downwards and the mouth faces entirely ventrad. There are ten tentacles with the disk at the top not much larger than the stem. At the lateral edge between the dorsum and the ventrum there are about eight pairs, sometimes one or two more, of lateral papillæ which gradually diminish in size from before backwards. The perisome is tolerably thick and translucent, the viscera inside showing through by their livelier hues. At the time, the sexual organs were ripe. The madreporic canal opened externally near the sexual opening.

Calcareous deposits: In the perisome, examined in both fresh and preserved states, there are only C-shaped bodies (text-fig. 39*c*) and large and small spiny bent rods (*a*). Both seem to be confined to the tips of the papillæ. It may seem that the species is referable to the genus *Kolga*, but there are present in the wall of the main reproductive duct many triradiate spicules and a smaller number of four-radiate spicules as well as C-shaped bodies (*b*).



Textfig. 39.

Periamma kumai: *a*—Bent rod; *b*—Triradiate rod from genital tubes; *c*—C-shaped body from genital tubes; *d*—Calcareous ring. (*a*—*c* × 240; *d* × ca. 65).

For this reason I put the species in the genus *Periamma*, although it seems intermediate between *Kolga* and *Periamma*. The tentacular crown has bent calcareous rods. In the calcareous ring, five slender spider-like radialia alone are present (*d*). Polian vesicle one.

49. *Enypniastes eximia* Théel.

(Pl. VII., figs. 59, 60).

Enypniastes eximia Théel 1882*b*, p. 56, Pl. VIII, figs. 6, 7.—Lampert 1885, p. 193.—Ludwig 1889—'92, p. 342.—Sluiter 1901*b*, p. 77, Taf. II., Fig. 8, 9, Taf. X., Fig. 5.—Perrier 1902, p. 433.—Hutton 1904, p. 286.

Specimens examined:—14 individuals examined fresh and mostly preserved in formalin or alcohol-water-glycerine mixture; from the northern parts of Suruga Bay at a depth of 600—750 *hiro*, collected by Mitsukuri and Aoki. May—June, 1905 (Spec. Nos. 1565—1578).

Thanks to the liberality of Dr. B. Dean, I was enabled to send our veteran collector Aoki to Suruga Bay during the latter part of May, 1905. He soon reported that he had caught a beautiful holothurian at about 600 *hiro*'s depth, not far from Numazu. The specimens, which were sent preserved, showed that they belonged to a soft and delicate species very hard to preserve. Accordingly, I went with the laboratory artist Mr. Sakuma to Numazu to study the species in the fresh condition. Aoki brought up several specimens for us to study. The figures (Pl. VII., figs. 59, 60) are made from the sketch and notes made by the artist on the spot. The study of the specimens convinced me that in spite of several not insignificant differences, the species is *Enypniastes eximia* of Théel. The occurrence of the species at two localities as distant as New Zealand and Japan seems remarkable enough, but I do not think they can be referred to a different species, and the wonder is somewhat lessened, when it is remembered that the "Siboga" obtained the species at an intermediate spot, i.e., near the island of Ceram in the Moluccas.

Both THÉEL and SLUITER had imperfect specimens, and their descriptions contain therefore several mistakes such as would naturally be caused by imperfect materials. In fact, my own preserved specimens show more points of agreement with the descriptions than the fresh specimens do. THÉEL's description of the genus runs as follows:—

"Body very depressed, with an extension of the body-wall round its anterior extremity, constituting a very large, broad, and rather flat brim. Tentacles twenty (?). The dorsal surface with small projections round the margin of the brim and with some other very small processes on its ambulacra. Pedicels along the sides and round the posterior extremity of the body."

The figures (Pl. VII., figs. 59 and 60) show that the body is far from being depressed. In fact, it shows a considerable height, the ventral sole being flat, and the dorsal surface being considerably vaulted. What was made out by THÉEL to be a broad brim around the anterior extremity of the body is not such at all. It should rather be compared to the dorsal hood-like appendage seen in *Peniagone* and allied genera. The mouth is ventral, and the large circular oral field is surrounded by 20 large aspidochirote tentacles. From the anterior end of the mouth-field, the dorsal appendage stands up like a hood. It is composed of 12—14 large finger-like appendages enclosed in a common membrane, but each appendage can be easily recognized from the outside, and its peripheral end seems to project a little beyond the edge of the membrane. The outermost epidermis covering the whole body is extremely delicate and is easily torn off in shreds. Below it, there is a rather thick layer of jelly-like connective tissue, which seems to fill up entirely the space between the outer epidermis and the inner layer next to the peritoneum. The

epidermis and the jelly-like layer seem to be lost in preserved specimens. The epidermis is of the beautiful bright color given in the illustration, but even in the fresh condition, this color changes to a dull red, and to green in patches which seem to increase in extent and number as time goes on (compare figs. 59 and 60 in Pl. VII). On each of the dorsal ambulacra, there were three slender papillæ in the anterior part of the body; the posterior two of them are visible in the figure. Along the lateral ambulacra, there were twelve or more appendages. In one case at least, of the twelve the six posterior were longer and crowded, while the anterior six were smaller and more scattered. On the dorsal median line, in one specimen at least, there was a papilla in the anterior part, at the tip of which the genital organ and the stone-canal seemed to open. There was no pedicel on the ventral median ambulacrum. The body was about 18 cm. long, and 9 cm. high at the anterior end. Like Théel and Sluiter, I could not find any calcareous bodies in any part of the body, and as I used fresh specimens for observation, this could not have been due to dissolution; so I think, we must consider the species to be without any calcareous spicules.

Sluiter gives some anatomical details. I may say that preserved specimens came to assume appearances very much like his figures (Pl. II., figs. 8, 9). According to Sluiter, the tentacles are not all of equal size: the dorsal being smaller than the ventral. This I am unable to see. They all seem to be of a uniform size. The oral field is 35 mm. in diameter. The end-shield of the tentacles has a slender neck making each tentacle look like a bottle. The diameter of the shield is about 6—7 mm. Sluiter mentions that the intestine lacks the usual convolutions and is almost straight. In the specimen I dissected, the intestine dis-

played the usual convolutions, showing nothing remarkable in this respect. Each genital bundle consists of a number of closed sacks in which I could detect remnants of eggs.

Locality :—"Challenger" Stat. 168 (Théel '82); "Siboga" Stat. 173 (Sluiter '01); Sagami Sea.

Family III. CUCUMARIIDAE.

Genus **Colochirus** Troschel 1846.

50. *Colochirus doliolum* (Pallas).

(Pl. I., figs. 10—11).

Actinia doliolum Pallas 1766, p. 152, Tab. XI., Fig. 10.

Holothuria doliolum (partim.) Lamarck 1816.

Pentactes doliolum (partim.) Jaeger 1833, p. 12.

Cladodactyla doliolum? Brandt 1835, p. 45.

Cucumaria doliolum Selenka 1867, p. 348, Taf. XX., Fig 108.—Semper 1868, pp. 53, 269.

Colochirus doliolum v. Marenzeller 1874, pp. 303—4.—Lampert 1885, p. 128.—Théel 1886*a*, p. 125.—Ludwig 1887*b*, p. 1229.—Ludwig 1888, p. 818.—Ludwig 1889—'92, p. 349.—Lampert 1889, p. 819.—Sluiter 1894, p. 104.—Pearson 1903, p. 196.

Colochirus australis Ludwig 1874, p. 12, Fig. 15.—Bell 1886, p. 148.—Lampert 1885, p. 123.—Théel 1886*a*, p. 122.—Sluiter 1887, p. 205, Taf. II., Fig. 20—22.

Colochirus minutus Ludwig 1874, p. 13.—Lampert 1885, p. 123.—Théel 1886*a*, p. 121.

Colochirus pygmæus Théel 1886*a*, p. 83. Pl. IV., fig. 9.

Specimens examined :—

Sci. Coll., Spec. No.	No. of individuals	Preservation	Locality	Depth in *hiro*	Collector	Date
1641	7	Alc.	2 miles W. of Jōgashima, Sagami.	25		July 26, '91.
1089	2	„	?			
1097	Many	„	West of Niishima, Izu.			
1096	Several	„	Kagoshima Bay		Nakagawa	
1100	4	„	Koajiro and Bishamon, near Misaki, Sagami.		Mitsukuri	July, '97.
1133	1	„	Tokyo Bay	10—15	Owston	Oct. 22, '99.
1642	3	„	Negishi near Yokohama	30	„	Sept. 23, '00.
1643	1	„	Hokkaidō		Nozawa	Feb. 15, '97.
1644	4	„	Shimoda, Izu.		Hirota	Aug. 28, ?
1645	1	„	Doketsuba, Sagami Sea.	130	Aoki	Aug. 9, '97.
1646	1	„	Shimo-Chikura I., Prov. Satsuma.	70	Miyajima	July 3, '00.
1647	9	„	35° 10′ N., 139° 41′ E. (near Misaki).	30	Owston	June 8, '02.
1654	7	„	Ozaki, Ago Bay, Prov. Shima.	Shore	Nishikawa	May 10, '06.

Description :—„Die Exemplare, von denen mir elf vorliegen und deren grösstes 7 Cm. lang und 12 Mm. dick ist, haben eine scharf vierkantige Gestalt, welche am vorderen Körperende durch stärkeres Vorspringen des mittleren ventralen Radius fünfkantig wird. Sie sind graubraun gefärbt, auf dem Bauche ein wenig heller als auf dem Rücken. Die Füsschen sind weiss mit braunen Endscheiben und stehen auf dem Trivium in drei ziemlich von

einander abstehenden Längsreihen zu je zwei, seltner zu je drei nebeneinander. In den Radien des Rückens finden sich 1—2 Papillenreihen, die Interradien sind gänzlich frei von Papillen. Der After ist mit kleinen Kalkzähnen versehen. Von Kalkgebilden finden sich in der Haut zahlreiche knotige Schnallen, welche sich zu grossen Kalkplatten umwandeln. Diese letzteren sind auf dem Rücken grösser als auf dem Bachen, bis 2 Mm. gross. Man kan die Kalkplatten in der Haut schon bei äusserer Betrachtung deutlich wahrnehmen. In den Wandungen der Füsschen finden sich zahlreiche Stützstäbchen. In der oberflächlichen Hautschicht liegen umgewandelte Stühlchen, welche durchbrochene Halbkugeln darstellen, deren Scheitel durch das Zusammentreten von regelmässig vier Kalkstäben gebildet wird und deren offene Basis bei jüngeren Formen durch einen einzigen Querstab, bei älteren Formen durch mehrere gedornte Querstäbe geschlossen wird. Die drei am meisten ventralen Glieder des Kalkringes sind nahe aneinander gerückt, entsprechend den zwei kleinen ventralen Tentakeln. Die zehn Tentakel sind dunkelbraun und gelb gefleckt und haben einen stark verkalkten Stiel. Die Geschlechtsorgane heften sich etwas hinter dem Ansatz der Retractoren an, welche selbst 1/3 vom Vorderende inseriren. Sie bestehen aus zwei Büscheln unverästelter, brauner, 1—1½ Cm. langer Schläuche. Links am Gefässring eine einzige 7 Mm. lange Poli'sche Blase; ein dorsaler, im Mesenterium festgelegter Steinkanal." (Ludwig 1874, pp. 12—3.)

Remarks :—This seems to be one of the most widely distributed species of Dendrochirotæ in Japan. It is found from Hokkaidō in the north down to Kagoshima in the south. The largest specimens before me (No. 1642) are 4.3 × 1.5 cm. and 5 × 2 cm. They are quadrangular in shape, but towards the anterior end are

decidedly pentangular, the median ventral ambulacrum becoming prominent. These five angles correspond to the five valves by which the mouth is closed. The three ventral ambulacra are distinct, each showing about two pedicels standing side by side at the ends, but in the middle more than two. In the dorsal lateral rows of papillæ, the bases of these are surrounded by spiny elevations formed by calcareous plates which make the whole body stiff and hard. All the interambulacra are naked and in most specimens darker colored than the ambulacra. Tentacles ten; two ventral tentacles smaller than the rest. Calcareous ring simple: I can not discover that any of the joints are narrower or more crowded than the rest. Polian vesicle one. Stone-canal one, attached to the dorsal mesentery. Genital tubes unbranched. Retractors inserted at about 1/4 of the body length. Anus with five small teeth. Calcareous deposits of three kinds: (i) small reticulate hemispheres, (ii) knobbed buttons, and (iii) large plates. In addition to these there are found (*a*) supporting rods, (*b*) tentacular supporting rods, and (*c*) distinct end-plates.

Locality:—Cape of Good Hope (earlier authors); Bowen (Ludwig '74); Sydney (Ludwig '74); Port Jackson (Bell '86); Port Molle (Bell '86); New South Wales (Lampert '86); West Australia (Lampert '86); Amboina (Ludwig '88, Sluiter '94); Bahia (Théel '86); Billiton (Sluiter '87); Ceylon (Pearson '03); East Coast of Japan, from Hokkaido to Satsuma.

51. *Colochirus inornatus* v. Marenzeller.

(Pl. VIII, fig. 73; textfig. 40).

Colochirus inornatus v. Marenzeller 1881, pp. 130—2, Taf. V., Fig. 7. —Lampert 1885, p. 127.—Théel 1886*a*, pp. 77, 120, Pl. VI., fig. 8.—Lampert 1889, p. 824.

Thyone inornata Ludwig 1889—92, p. 346.

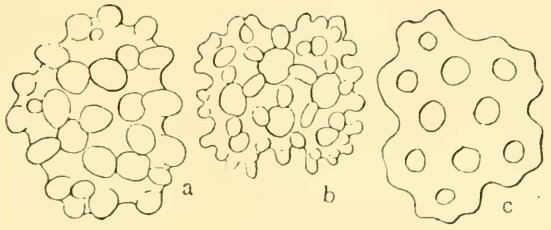
Specimens examined :—

Sci. Coll., Spec. No.	No. of individuals	Preservation	Locality	Depth in *hiro*	Collector	Date
1078	9	Alc.	Negishi Bay, near Yokohama.	22	Owston	Sept. 3, '99.
1638	2	„	Tokyo Bay	10—14	„	Oct. 22, '99.
1639	1	„	„	6	„	Nov. 3, '99.

Description :—" All the specimens highly contracted, with the tentacles retracted within the body which presents a fusiform appearance. The mouth closed by five valvular projections, and is in most of the individuals bent upwards. The perisome is rather hard and inflexible. The anal portion of the body is much more tapered and distinctly turned upwards. The anus is surrounded by five very minute teeth. The two ventral are much smaller than the eight remaining tentacles. All the ambulacral appendages, even the dorsal ones, are completely retractile, and distributed all over the body, whereby the surface of the latter acquires a punctated or finely pitted aspect. No dorsal processes or elevations of the body-wall, which are so characteristic of most of the representatives of the genus *Colochirus*, are visible. Only in one specimen does the dorsal surface show traces of some minute elevations " (Théel, p. 77).

Remarks :—All the specimens are sausage-shaped. Their length and breadth as measured in a few are : 5.5×2.5 cm., 5×2.5 cm., 4.5×2 cm., and 2.3×1 cm. They are highly contracted, and all the ambulacral appendages are retracted. The skin is thick and hard, and gives the impression of having a heavy deposit of calcareous bodies. The mouth when closed, shows five radiate lines : it is stellate in shape. The anus is turned on to the dorsal

surface, and is surrounded by five minute teeth. Ambulacral appendages are scattered all over the body. On the ventral surface, the three ambulacra are distinctly marked by longitudinal rows of minute holes within which the pedicels have retracted. They are most marked in the middle of the body, for in this part pedicels are less numerous in the interambulacra than nearer the two ends of the body. The dorsal surface, which is colored brown, is thickly and uniformly crowded with the holes within which ambulacral appendages have retracted. I have not been able to ascertain whether these are pedicels or papillæ. The ventral surface is of a lighter color. In the two specimens examined for the purpose, the tentacles were twelve in number, of which the two ventral were smaller than the rest. In the calcareous ring the lateral ventral radialia of both sides are represented each by two pieces. I can not see that the ventral pieces are any narrower than the rest. Polian vesicle one, on the left lateral radius. Stone-canal one, with a large lobulate madreporic body on the mesenterium.



Textfig. 40.

Colochirus inornatus: *a*—Knobbed button; *b*—Reticulate, knobbed cup; *c*—Perforated plate. (× 300).

The calcareous deposits in the perisome are of three kinds: (i) delicate, reticulate, flat cups with some knobs (textfig. 40*b*), (ii) thick, robust buttons with large rounded knobs (*a*), and (iii) plates which are not very large (*c*). In the pedicels are found well-developed end-plates with longish irregular, many-holed supporting rods.

Although this species is put by LUDWIG in the genus *Thyone*, it seems to me that the presence of a sole and the resemblance of its calcareous deposits to those of *Colochirus doliolum*, make it desirable to retain it in the genus *Colochirus*.

Locality :—Japan (v. MARENZELLER '81, LAMPERT '85, THÉEL '86); Gulf of Tokyo.

Genus **Psolus** OKEN 1815.

52. *Psolus ascidiiformis*, sp. n.

(Pl. I., figs. 13—15; textfig. 41).

Specimen examined:—One alcoholic specimen from off Miyako, Prov. of Rikuchū, 500 *hiro*. Wakiya Coll., Feb. 1903. (Sp. No. 1650).

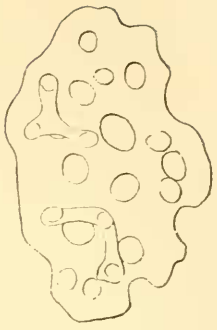
I can not identify this with any of the previously described species.

In alcohol, it is almost black in color. The shape is decidedly ascidian-like, both the oral and anal processes standing up from the body more than 1 cm., the former being much larger than the latter. The sole is trapezoidal in shape, the anterior end being much broader than the posterior. There is no sign of pedicels in the median ambulacrum. Around the margin of the sole, there are two rows of pedicels, one within the projecting rim of the sole, and the other just at the edge of the said rim.

The whole dorsal surface not included in this sole is covered with large scales. These are rather small around the edge of the sole, but become larger towards the sides, the largest scales of the body being found about half way up. They are without any grains and are imbricated. I can not find any specially large scales or any regular arrangement of them around the mouth or anus. In alcohol, the surface shows corrugations.

The calcareous deposits in the sole (text-fig. 41) are very numerous and crowded, so that in cutting out a piece with scissors, a peculiar grating sound is heard. They consist of plates of various irregular shapes, bearing from a few to many knobs on the surface. The ends of the knobs often join to form the characteristic fenestrated plates, parallel to the original plate. The edges of these plates are more or less scalloped.

From the only specimen on hand the number of tentacles, etc., could not be ascertained.



Textfig. 41.

Psolus ascidiiformis. Knobbed plate from sole. × 200.

53. *Psolus squamatus* (Müller).

(Pl. VII., figs. 61—62; textfig. 42).

Holothuria squamata Müller 1788, Taf. X., Fig. 1—3.

Cuvieria squamata? Jæger 1833, p. 20.—? Blainville 1834, p. 192.—Düben och Koren 1844, pp. 222—6, Taf. IV., Fig. 35—41.—Koren 1845, Fig. 1—16.—Lütken 1857, p. 69.—Selenka 1867, p. 343.

Psolus squamatus Andrew and Barret 1857, p. 45.—Sars 1858, p. 169.—Sars 1861, pp. 112—3.—Semper 1868, pp. 62, 272.—Bell 1882, p. 645.—Lampert 1885, p. 119.—Kükenthal und Weissenborn 1886, p. 780.—Ludwig 1889—'92, p. 350.—Pfeffer 1890, pp. 88, 95.—Nordgaard 1893, pp. 5, 10.—Norman 1893, p. 349.—Meissner und Collin 1894, p. 345.—Grieg 1894, p. 4.—Sluiter 1895, p. 81.—Appellöf 1896, p. 12.—Grieg 1897, pp. 4, 7, 11, 12, 24.—Ludwig 1898*a*, pp. 58, 61.—Bideknap 1899, p. 106.—Ludwig 1900, p. 158.—Clark 1901*a*, p. 171.—Clark 1901*d*, p. 491.—Östergren 1902, p. 10.—Perrier 1902, pp. 513—4.

Lophothuria squamata Verrill 1873.

Psolus (*Cuvieria*) *squamatus* var.? Théel 1886*a*, pp. 89, 129, Pl. XV., figs. 1, 2, Pl. VI., fig. 2.—?Perrier 1904, p. 16.

Psolus squamatus var. *segregatus* Perrier 1905, p. 59.

Specimens examined :—

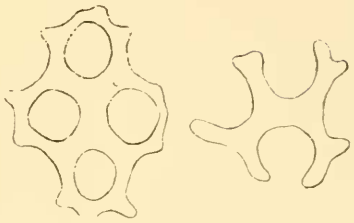
Sci. Coll., Spec. No.	No. of individuals	Locality	Depth in *hiro*	Collector	Date
1077	3	Matsuwa-Lighthouse-line, Numa, Sagami Sea.	400	Aoki	Jan 25, '97.
1649	1	Outside Okinosé, Sagami Sea.	400	,,	Jan. 28, '04.
1651	1	Outside Okinosé, Iwado-line, Sagami Sea.	400	,,	Jan. 20, '97.
1652	1	Outside Okinosé, Ige-line, Sagami Sea.	400	,,	Mar. 17, '99.

Description :—" Body depressed. Lateral series of pedicels composed of two to four rows. Odd ambulacrum always naked, though it possesses some pedicels in its anterior and posterior portions. Scales large, imbricating upon one another, with rather uneven margin, and covered with fine granules only. The sole devoid of the cup-shaped bodies is supported by more or less scattered, irregular, reticulate, slightly spinous or knobbed plates " (Théel 1886, p. 129).

Remarks :—It is with some hesitation that I refer these specimens to *P. squamatus*. As *P. fabricii* has been previously reported from Japan (Bell 1882), I naturally expected to find that these specimens belonged to that species, but although they look very much like a specimen of that species from Massachusetts Bay in North America, there is one fatal objection to identifying them with *P. fabricii*. That is, the calcareous deposits of the sole are entirely devoid of reticulate cups, and on the whole are much like those figured by Théel as found in the sole of *P. squamatus* (textfig. 42). Further, the agreement in other characters with the

description given of *P. squamatus*, is so close that I have considered it safest to refer them to the present species.

All the specimens are from the Sagami Sea, and all from a depth of 400 *hiro* (=333 fathoms, a depth greater than that hitherto reported). They possess ten tentacles. The odd ambulacrum of the sole possesses some pedicels in the anterior and posterior portions, but is devoid of pedicels in the middle, which is by far the largest part. Pedicels around the margin of the sole are in 3—4 rows. Dorsal scales are beset with fine grains. I can not find that they have any special arrangement around the mouth or anus. The sizes of the specimens are: 7×2.5 cm.; 7×2 cm.; 6.5×4 cm.; 6×4.5 cm.; 5.5 × 2 cm.; 4×1.5 cm. The comparatively small widths are apparently due to the lateral compression to which the specimens had been subjected.



Textfig. 42.

Psolus squamatus: Perforated plates of sole. × 200.

Locality:—Sund; Greenland; Kuriles (Selenka '67, Semper '68); West Coast of Scandinavia from Bergen to Lofoten and Finmark (Sars, Düben och Koren, Danielssen og Koren, Möbius und Bütschli, Andrew and Barret); British Is. (Norman, Hodge); Gulf of St. Laurence (Bell); Coast of New England (Verrill); Barents See, Pergensfjord (Sluiter '95); Pacific Grove, Cal. (Clark '01); Sagami Sea.

Genus **Thyone** Oken 1815.

54. *Thyone sacellus* (Selenka).

(Pl. VII., fig. 63; textfig. 43).

Stolus sacellus Selenka 1867, p. 355, Taf. XX., Fig. 115—6.

Thyone rigida Semper 1867—'68, p. 66, Taf. XIII., Fig. 23, Taf. XV., Fig. 7.

Thyone saccla Semper 1867—'68, p. 66.—v. Marenzeller 1881, p. 134.—Théel 1886*a*, p. 138.—Sluiter 1887, p. 206.—Sluiter 1895, p. 80.

Stereoderma murrayi Bell 1883, p. 61, Pl. XV., figs. 6, 6*a*, 6*b*.

Thyone saccllus Bell 1884, p. 149.—Lampert 1885, p. 154.—Lampert 1889, p. 834.—Ludwig 1889—'92, p. 346.—Ludwig 1899, p. 561.—Sluiter 1901*b*, p. 93.—Pearson 1903, p. 192, Pl. I., figs. 9, 10.

Thyone (*Stolus*) *saccla* Mitsukuri 1896, p. 410.

Specimens examined :—

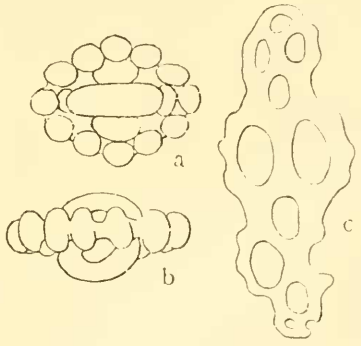
Sci. Coll., Spec. No.	No. of individuals	Preservation	Locality	Collector	Date
1626	9	Alc.	Kurokami-mura, Sakura-Jima, Prov. Satsuma.	Higashi	May, '97.
1073—4	2	,,	Kagoshima Bay, Satsuma.	Nakagawa	
1093	1	,,	Mizoë, Ariake Bay, Prov. Hyūga.	Mitsukuri & Hara	Apr., '96.
1637	1	,,	Ushifuka, Amakusa, Prov. Hizen.	Murakami	Aug. 8, '00.

Description :—" Körperhaut hart, von zahlreichen 0.05 Mm. langen und 0.038 Mm. breiten Kalkkörpern erfüllt, die aus zwei senkrecht in einander gestellten Ringen zusammengesetzt sind, von denen der grössere perlschnurartig verdickt ist.—Thier dunkelsammtbraun oder braunviolett. Eine Anzahl Exemplare von 5 Cm. Länge und 2 Cm. Dicke liegen mir vor. Die Longitudinalmuskeln sind sehr schmal; in ihrer Mitte entspringen die Retractoren des ziemlich grossen Schlundkopfes. Die Stücke des Kalkrings setzen sich aus zahlreichen polygonalen aneinander articulirenden Plättchen zusammen; die Radialia, bis auf die vordere Spitze, gespalten und nach hinten in einen langen Gabelschwanz verlängert, welcher die Tentakelcanäle umfasst. Der schmale Ringcanal trägt 12—20

freie, kleine Steincanälchen und 4 Poli'sche Blasen. Die Saugfüsschen besitzen deutliche Ampullen. Geschlechtsschläuche ungetheilt; Kloake durch zahlreiche Muskeln gehalten." (SELENKA 1867, p. 355.)

Remarks:—Body in many specimens kidney-shaped, dorsally bent so that the ventral median line is longest. Skin hard and coriaceous, with deep wrinkles. Color yellowish brown. Segments of calcareous ring are each composed of many small pieces set like a mosaic. Radialia bifid, with long posterior prolongations. Polian vesicles several (in one specimen eight); stone-canals and madreporic bodies many, as represented in SELENKA's Fig. 115.

Calcareous deposits as in SELENKA's Fig. 116. Four-holed buttons with knobs around the margin, so that they look like a pearl-necklace (textfig. 43 *a*,*b*), with a second ring crossing the first at right angles. End-plates imperfect. Large four- or more-holed buttons (*c*) present as supporting rods around the ends of the pedicels.



Textfig. 43.

Thyone sacellus: *a*, *b*—Four-holed, knobbed buttons; *c*—Perforated plate of pedicel. (×400).

Locality:—Zanzibar (SELENKA '67, LAMPERT '85, LUDWIG '99); Bohol, Canal von Lapinig (SEMPER '67—8); Japan (v. MARENZELLER '81); Aden (v. MARENZELLER '81); Torres Strait (BELL '84); Mozambique (SEMPER '69, THÉEL '86); Java (SLUITER '87); West Coast of Salawatti (SLUITER '01); Molo Strasse (SLUITER '01); Labuan Badjo (SLUITER '01); "Siboga" Stat. 77 (SLUITER '01); Negombo, Ceylon (PEARSON '03); S. of Kyūshū.

Genus **Phyllophorus** Grube 1840.

55. *Phyllophorus japonicus* (v. Marenzeller).

(Textfig. 44).

Thyonidium japonicum v. Marenzeller 1881, p. 134, Taf. V., Fig. 9.—Lampert 1885, p. 173.—Théel 1886*a*, p. 148.

Phyllophorus japonicus Ludwig 1889—'92, p. 347.

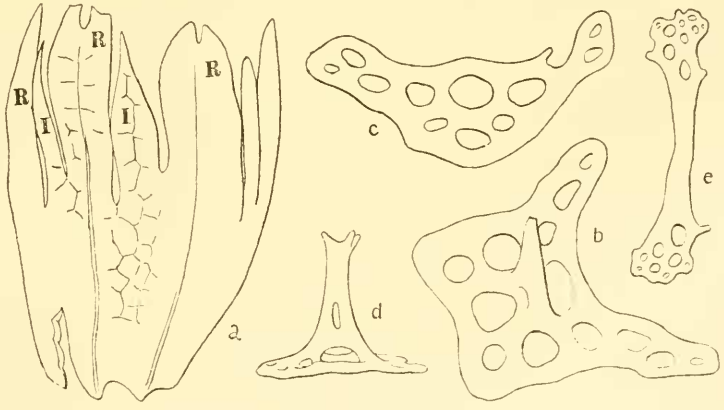
Specimens examined: —

Sci. Coll., Spec. No.	No. of individuals	Preservation	Locality	Collector	Date
1094	1	Alc.	Haneda, Tokyo Bay.		Oct. 12, '83.
1130	1	„	Uraga channel, off Tsurugizaki.	Owston	Sept. 17, '99.
1655	1	„	Kurozaki and Takeyama, Sagami Bay, 48 *hiro*.	„	May 24, '99.

Description: — "Die 10 grossen Tentakel ungefähr 5 mal länger (20 Mm.) als die 10 kleinen. Die überall zerstreuten Füsschen nicht völlig retractil. Kalkkörper der Haut dichtgelagerte einfache durchlöcherte Platten ohne Knoten von mannigfacher Gestalt. In den Füssen ausser den Endscheiben gebogene breite Stäbe, in deren Mitte sich ein langer Stachel erhebt und in einzelnen der vordersten Füsse krause Körper. Die Radialia, die wie die Interradialia aus Zahlreichen Stücken zusammengesetzt sind, vorne dreimal ausgerandet, nach rückwärts in 2 nah bei einander liegende Schenekl ausgehend. Ansatzstelle der einfachen oder doppelten Retractoren 1/3 vom Vorderende. Von 2 untersuchten Ex-

emplaren hatte das eine 1, das andere 4 Poli'sche Blasen; bei beiden war 1 Steinkanal vorhanden. Geschlechtsschläuche sich dichotomisch verzweigend. 9,4 cm. lang, 2,8 cm. breit. Haut dick, sandig. Farbe braun in's Röthliche, die Füsschen weiss." (Lampert 1885, p. 173).

Remarks:—Of the specimens examined, only one (No. 1094) is of a medium size, viz., 9 cm. by 2.2 cm.; and this alone has a thick skin. It is spindle-shaped. The others (Nos. 1130 and 1655) are much smaller, being respectively 2.0 cm. by 1.3 cm. and 2.5 cm. by 1.5 cm. In these, the skin is thin and the body,



Textfig. 44.

Phyllophorus japonicus: *a*—Calcareous ring; *b*—Irregular perforated plate of perisome with imperfect spire; *c*—Same without spire; *d*—Table of tentacle; *e*—Supporting rod of tentacle. (*b*—*e* × 240). I—Interradialia; R—Radialia.

ovoid. In all, the pedicels are thickly scattered all over the body, over the ambulacra as well as the interambulacra. There is a tendency for them to crowd on one side (ventral ?), and this is very distinct in No. 1655. As to the tentacles, I was able to make out in No. 1094 nine large and eight small ones, making 17 in all. The color is white in alcohol. The calcareous ring is very

characteristic and elongated (textfig. 44*a*). Its segments are each composed of numerous small pieces. The radialia have blunt ends anteriorly, and present one median notch and two shallower lateral notches. The interradialia have anteriorly a single-pointed end. Posteriorly, the radialia have each a single prolongation divided into halves by a median canal-like line. The calcareous ring is 2.2 cm. long in No. 1094. In No. 1655, it is about half as long as the body. In each of these specimens, there were observed one Polian vesicle and one stone-canal.

Calcareous deposits:—the most common form are those scattered in the body wall. They are irregular perforated plates of all kinds of shapes, with or without a single-pointed spire in the center (*b*, *c*). The latter, may have a perforation near the base, indicating that it consists genetically of two pillars or columns. The bodies in question must of course be regarded as tables. Most characteristic are however the calcareous bodies of the pedicels. Around the end-plates, occupying the place of supporting rods of other holothurians, are numerous pointed bodies, which have vaulted bases shaped like a tripod. In the tentacles are better developed tables which have a perfect disk and a spire which shows two columns united into one near the top (*d*). In the anterior portion of the body and in the tentacles are finely built rosettes, as well as rods with enlarged and perforated ends (*e*).

Locality:—Japan (v. Marenzeller '81).

Genus **Cucumaria** Blainville 1830.

56. *Cucumaria capensis* Théel var. *parva*, var. n.

(Pl. VIII., Fig. 74; textfig. 45).

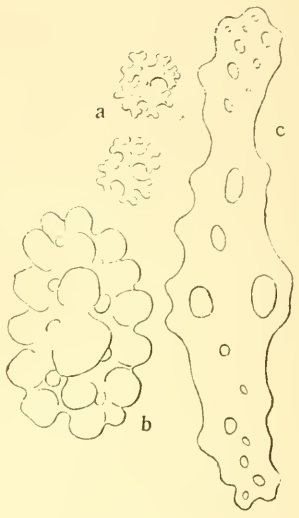
Specimens examined :—

Sci. Coll., Spec. No.	No. of individuals	Locality	Collector	Date
1620	Many	Jōgashima, Misaki.	Mitsukuri	Aug. 17, '03.
1621	Several	Moroiso, Misaki.	Hara	Aug. 20, '01.

Description :—Body subcylindrical with the anal portion slightly curved upward or dorsad. In life, I observed five delicate tentacle-like pedicels (or papillæ) around the anus. The pedicels in the middle parts of the ventral trivium are somewhat more pronounced than those in other parts, and give to the parts a sole-like appearance as in *Colochirus*. The pedicels in front and back of this sole-like part are more slender. These remind one of the small delicate papillæ described by Théel as a second kind of pedicels in *Cucumaria insolens*, but I can not find any such arrangement as described by that author for that species. The trivium is well pronounced showing numerous pedicels, while the dorsal bivium is more difficult to make out on account of the dark pigments in the entire dorsal region. There are two rows of pedicels in each ambulacrum. Tentacles ten, of which the two ventral are considerably smaller than the others and show scarcely any branches. Respiratory trees two, with a few branches. Calcareous ring without any posterior

prolongations. Stone-canal one, attached to the dorsal mesentery. Polian vesicle one, vesicular.

Calcareous deposits :—(i) Large scales or plates 0.6 mm. large, or smaller, easily visible with a hand-lens ; they give firmness to the perisome. The large-sized plates lead down to smaller forms with fewer openings (textfig. 45*b*). (ii) Small rosette-like figures, mostly cruciform in shape, lying outside of the scales (*a*). (iii) Supporting rods which, unlike those of Théel's specimens, or Sluiter's, are irregular plates with holes in irregular distribution (*c*).



Textfig. 45.

Cucumaria capensis, var. *parva* : *a*—Rosette-like, cruciform bodies ; *b*—Small form of scale or plate ; *c*—Supporting rod. (× 300).

Remarks :—This is one of the commonest holothurians near Misaki. The specimens were found attached in a considerable number to the shells of *Ostrea gigas*, as well as to sea-weeds, brought up by divers from a depth of 3—4 fathoms.

It is not without some hesitation that I identify these specimens with *C. capensis* of Théel. However, in the body form and anatomical relations, as well as in the distribution of pedicels and the character of calcareous deposits, they must be said to agree essentially with Théel's description. Only the specimens in question are very much smaller. Sluiter has found the same to be the case with his specimens. Théel's specimens measured 53 mm. and Sluiter's 33 mm., while mine are all less than 20 mm. at the most. One of the largest, when living, was 15 mm. × 4 mm. Under the circumstances it has seemed to me best to put this as a variety

of the species *capensis*.

An interesting œcological fact in relation to this holothurian in life came under my observation. An amphipod crustacean is often found lying on its back on the skin of the holothurian; the skin gradually heaves up around the crustacean, eventually to enclose it in a tightly fitting cavity, but not completely, for its ventral surface remains exposed and its four tentacles stick out freely, moving constantly. When the holothurian is kept in a jar, the crustaceans thus imprisoned all become liberated after a while, and the cavities in the skin which held them totally disappear, leaving no trace of having ever accommodated such commensals.

57. *Cucumaria chronhjelmi* Théel.

(Pl. VIII., figs. 71—72; textfig. 46).

Cucumaria chronhjelmi Théel 1886*a*, p. 105.—Ludwig 1889—'92, p. 344.—Clark 1901*c*, p. 334, Pl. IV., figs. 11—20.—Clark 1901*d*, p. 492.

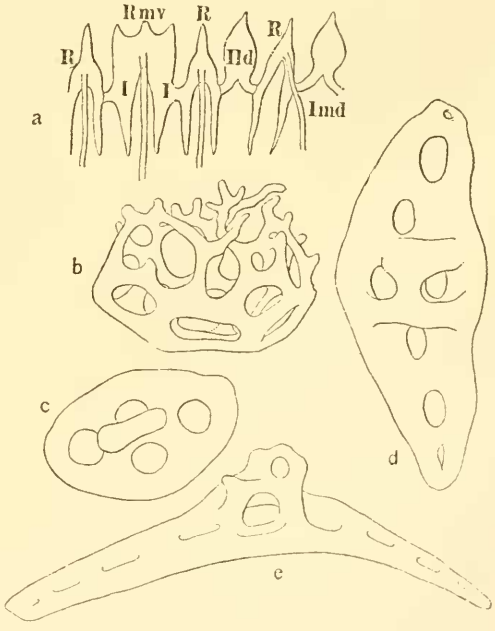
Specimens examined:—

Sci. Coll., Spec. No.	No. of individuals	Locality	Collector	Date
1082	2	Off Jōgashima, Sagami Sea, 70 *hiro*.	Aoki	Feb. 5, ?
1081	2	?		
1083	5	Susa, Chita District, Prov. Owari. (under stones).	Mitsukuri	Dec. 27, '95.
1098	1	Jōgashima		Mar. 31, ?
1099	2	Near the Sugashima Light-house, Toba, Prov. Shima.	Kishinouye & Inaba	July 16, ?
1134	1	Hakodate, Hokkaido.	Nozawa	Sept., '90.

Sci. Coll., Spec. No.	No. of individuals	Locality	Collector	Date
1610	1	Akkeshi, Prov. Kushiro, Hokkaido, 5 *hiro.*	Nozawa	Feb. 15, '97.
1612	2	Kanazawa, Prov. Musashi.	Mitsukuri	Aug. 2, '94.

Description :—" Body indistinctly pentangular. Pedicels numerous, cylindrical, long, forming apparently a double row along each ambulacrum ; at the middle of the body they seem to be more crowded, there being three to four rows, but this is probably a result of the contracted state of the body. Tentacles ten, two ventral smaller. Anus with small teeth. Polian vesicle and madreporic canal single. Calcareous ring very fragile, the interradial pieces being conical, pointed anteriorly ; the radial obtuse, furrowed anteriorly and terminating posteriorly in two very slender prolongations. Deposits crowded, of two kinds ; in the external layer of the perisome small reticulated spheres or globular cups; in the internal layer numerous hollow fenestrated ellipses of different sizes and shapes, some being of a more elongated form, others more rounded, globular, and some being several times larger than the rest ; among the larger ellipses are found here and there rather large scale-like bodies, composed apparently of a network of several superposed layers. Undeveloped ellipses, consisting of a small oval concave plate with four holes, may also be found. The pedicels have, round the large terminal plate, some irregular perforated plates, and, besides, numerous elongated rods with four holes at the slightly enlarged middle, and a row of holes along each arm ; the middle of the rods usually carries a kind of low conical, rounded spire. Length of the largest specimen, 55 mm. Colour whitish." (Théel).

Remarks :—My specimens on the whole agree well with the description of Théel. The largest sized one (No. 1082) measures 7.5 × 1.5 cm. Body indistinctly pentagonal. Tentacles ten, the two ventral ones smaller than the rest. Pedicels in double row on each ambulacrum; sometimes 3—4 rowed in certain parts, but this condition is due probably to contraction. Polian vesicles two. In one specimen, one of them is slender, and the other vesicular; in another, both vesicular. Stone-canal single, with a distinct madreporic body. Greatest discrepancy from Théel's description is presented by the calcareous ring. This is bilaterally symmetrical (textfig. 46*a*); the interradialia on both sides of the mid-ventral radialia are fused with the latter, thus forming a large piece exhibiting three points anteriorly and two prolongations behind. The lateral ventral radialia on each side of it has a single point anteriorly and is prolonged posteriorly into two long prolongations. The two dorsal interradialia are leaf-like with a single point forward, and are united to the posterior prolongations of adjacent radialia. The two dorsal radialia are like the lateral interradialia, and the



Textfig. 46.

Cucumaria chronhjelmi: *a*—Calcareous ring; *b*—Reticulated ellipse: *c*—Simple perforated plate; *d*, *e*—Elongated plates. (*b*—*e* × 300). I—Right and left ventral interradialia; Ild—Left dorsal interradialia; Imd—Middorsal interradialia; R—Radialia; Rmv—Midventral radialia.

middorsal interradialia is like the lateral dorsal radialia. There are five small teeth around the anus.

The calcareous deposits form two layers : The inner layer is very thick and crowded, consisting of thick elliptical plates with smooth margin. The smallest plates have four holes, there being very often a handle-like arch between the two holes in the longitudinal axis (*c*). In the larger plates, the four main holes are often eccentrically situated, in which cases the arch is also eccentric in position and lies longitudinally between the two main holes in the longitudinal axis. Some plates in the layer are of an elongate shape ; these show four main holes in the middle broad parts, besides having some more holes in a row in the narrower prolonged parts (*d*, *e*). The supporting rods of the pedicels are mostly of this form. They have a sort of tower in the middle. In the outer layer the calcareous deposits are not so closely packed together as in the inner layer. They are bodies which may best be called reticulated ellipses (*b*). They all have an elliptical basal plate with four or more distinct holes ; from any spot in the periphery of this basal plate, there may arise several smooth, slender rods. These branch, and the branches fuse whenever and wherever they come into touch. The result is a basket-like table with a very complicated tower, the appearance from above being simply that of a bush consisting of small branches with smooth tips. All stages of development may be observed.

This species seems to be a northern one. It is known by the name of " Ishiko " in Prov. Owari.

Locality :—Vancouver's I. (Théel '86) ; Puget Sound (Clark '01) ; Pacific Grove, Cal. (Clark '01) ; Pacific coast of Japan from Hokkaido to Prov. Shima.

58. *Cucumaria echinata* v. Marenzeller.

(Pl. VIII., fig. 70; textfig. 47).

Cucumaria echinata v. Marenzeller 1881, p. 127—8, Taf. V., Fig. 9.—Lampert 1885, p. 137.—Théel 1886*a*, p. 103.—Ludwig 1891, p. 344.—Mitsukuri 1896, p. 409.

Specimens examined:—

Sci. Coll., Spec. No.	No. of individuals	Locality	Depth in *hiro*	Collector	Date
1587 etc.	Numerous	Koajiro, Misaki.		Mitsukuri	
1591, 1596	„	Bishamon near Misaki	8—20	„	
1592	1	Odawara, Prov. Sagami.			
1593	12	Shinojima, Prov. Owari.		Sasaki	Oct. 28, '96.
1090	3	West of Jōgashima, Misaki.	25	Aoki	Dec. 26, '91.
1602		Jōgashima		„	Apr. 20, '94.
1087	1	Misaki			
1608	1	„		Owston	Apr., '98.
1609	1	Entrance of Koajiro Bay	12	„	May 28, '99.

Description:—"Neben fünf nur 18 mm. langen und 10 mm. breiten Exemplaren ein ausgewachsenes von 50 mm. Länge. Der Körper dieses Thieres ist zum Theil unnatürlich ausgeweitet, daher über die Breite nichts Genaues angegeben werden kann. Die Gestalt scheint eine tonnenförmige zu sein. Die Farbe gegenwärtig weisslich, nur an den kleinen Exemplaren hie und da Spuren eines braunen Pigmentes. Die Haut nicht derb, etwas

rauh. Füsschen nur auf den Radien, zweireihig. Sie ragen, wiewohl contrahirt, etwas über die Oberfläche vor und fallen durch die Grösse ihres Durchmessers, der an dem grossen Individuum etwas über 1 mm. beträgt, auf. Von den zehn Tentakeln sind zwei ventrale viel kleiner. Die Radialia des Kalkringes 5.5 mm. lang, hinten in zwei kurze, breite und stumpfe Schenkel ausgehend. Die Rückwärts eingebuchteten, nach vorne rasch zugespitzten Interradialia kaum 3 mm. lang. Eine 10 mm. lange, schlauchförmige, 2 mm. breite, nach hinten spitz zulaufenden Poli'sche Blase. Ein Steincanal im dorsalen Mesenterium, mit grosser knopfförmiger Madreporenplatte. Die Retractoren wenig vor der Mitte der Leibeslänge entspringend. Ich sehe sie zum Theil mit zwei Wurzeln versehen und der linke dorsale ist durchaus bis zum Kalkringe der Länge nach getheilt. Die Geschlechtsfollikel sehr zahlreich, dünn, ungetheilt, ca. 15 mm. lang. Sie vereinigen sich beiläufig in gleicher Höhe wie die Ursprungsstelle der Retractoren zum Ausführungsgange.

Die Kalkkörper der Haut knotige Schnallen, von deren Extremität, einen sehr stumpfen Winkel mit derselben bildend, ein langer Stachel aufsteigt. Dieser Stachel muss als ein nicht im Centrum und schief stehender Stiel angesehen werden; die Spitzen der Stachel durchdringen die Cuticula. Die Scheiben sind häufig nicht so derb als die gezeichnete Form, sondern viel feiner und groblöchiger; oft findet man solche Platten ohne Stachel, und es ist nicht immer zu entscheiden, ob er verloren gegangen oder unausgebildet geblieben. Diese feineren Platten sind auch mit spitzeren, mehr vorspringenden Knoten besetzt.—In den Wandungen der Füsschen findet man Kalkstäbe, welche bald scharf gekrümmt, bald flach sind. Ihre verbreiterten Enden sind durchlöchert; von ihrer Mitte erhebt sich ein Stiel, der in der verschiedensten Weise

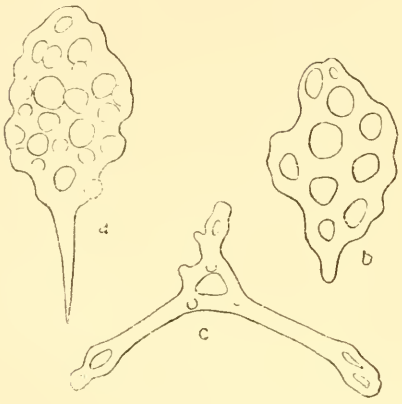
ausgebildet sein kann. Selten ist er nur zu einem Knopf reducirt, häufig eine einfache Spange oder ein längeres stumpf oder spitz zulaufendes glattes Gitterwerk, oder endlich ein langer Stachel." (v. Marenzeller).

Remarks:—This is perhaps the commonest dendrochirote holothurian on the coast of Japan. At any rate, in places around the Marine Laboratory at Misaki, e.g., at Bishamon and Koajiro, this occurs at times in such abundance that many boats dredge for them day after day, and by evening each one is loaded down with them. They are utilized as manure, and go by the name of "Gumi." They occur anywhere from three to four fathoms, down to twenty-five fathoms or more. In the fresh state, they have a pinkish tinge, turning white in alcohol. When preserved, the largest in my possession measure from 6 × 2 cm., and thence down to minute sizes. The trivial ambulacra are somewhat nearer one another than the bivial ambulacra; moreover, they lie nearly in the same plane, so that the ventral surface is easily distinguished from the dorsal surface by external examination. Tentacles ten, two ventral ones markedly smaller than the rest.

Calcareous ring: radialia with two short blunt posterior prolongations with a bay between. Interradialia anteriorly abruptly pointed, posteriorly hollowed into a deep bay. As in the original description, stone-canal one, with a large madreporic knob. Polian vesicle one, 8 mm. long. Longitudinal muscles split near the middle of the body. Two slender respiratory trees present. Pedicels two-rowed along each ambulacrum. Reproductive tubes numerous, bushy, simple, short, and unbranched; the longest about 1.4 cm.

Calcareous bodies:—In the body-wall knobbed buttons, one end of which is prolonged into a long pointed process (textfig. 47*a*).

This sticks out with its point from the surface of the skin. Scattered between them, are much rarer, smooth buttons with numerous holes (*b*). In the pedicels, there are in the lower parts knobbed buttons with sharp pointed processes, the points of which project out from the surface like the spines of the hedge-hog. Near the terminal part, the supporting rods are either slender and simple or triradiate rods, with one or more of the ends enlarged and perforated (*c*). Finally, there are many-holed delicate end-plates.



Textfig. 47.

Cucumaria echinata: *a*—Knobbed button with a sharp process; *b*—Perforated plate; *c*—Triradiate supporting rod. (× 240.)

In its native habitat, the species clothes itself with pieces of shells and stones, which are held on the body by the action of the pedicels. Kept in jars, it throws off these pieces. In the breeding season (the summer) the ripe individuals throw out reproductive elements. The males shoot forth the spermatic fluid, after which the females begin to shed eggs, which easily undergo development under observation.

Undoubtedly this species is found in other localities of Japan than Sagami Bay.

Locality :—Japan (v. MARENZELLER 1881); Sagami Bay; Prov. Owari.

59. *Cucumaria japonica* SEMPER.

(Pl. VIII., figs. 67—68; textfig. 48).

Cucumaria japonica SEMPER 1867—'68, p. 236, Taf. XXXI., Fig. 5; Taf.

XXXIII., Fig. 7; Taf. XXXIV., Fig. 10; Taf. XXXVIII., Fig. 5, 6, 8, 9, 12, 13; Taf. XXXIX., Fig. 2, 3, 7, 18.—Lampert 1885, p. 143.—Théel 1886*a*, p. 110.—Ludwig 1889—'92, p. 344.—Sluiter 1895, p. 80.—Mitsukuri 1896, p. 409.—Clark 1902*a*, p. 562.

Specimens examined :—

Sci. Coll., Spec. No.	No. of individuals	Preservation	Locality	Depth in *hiro*	Collector	Date
1604, 1606	4	Alc.	From Sendai Market		Shishido	May 10, '97.
1605	2	„	Ojika Peninsula, Prov. Rikuzen		Izuka	Dec. 26, '99.
1607	1	„	Akkeshi, Prov. Kushiro, Hokkaidō.	5	Nozawa	July, '00.
1084	1	„	Hakodate, Hokkaidō.		„	'90.

Description :—" Diese Cucumaria, von der mir zwei Exemplare aus Japan (durch Salmin) vorliegen, ist fast gar nicht von der europäischen *Cucumaria frondosa* zu unterscheiden. Doch fehlt ihr fast jede Spur eines Kalkringes, der doch bei der europäischen Art vorhanden ist; in der Tiefe der bindegewebigen Umhüllungshaut des Schlundsinus finden sich als Ueberbleibsel der radialen Glieder je zwei kleine Stücke schwammiger Kalkmasse. Ferner besitzt sie in der Haut nahe an der Cloakenöffnung sehr grosse radial gestellte Kalkplatten—welche bei *Cucumaria frondosa* fehlen —und ausser in den Füsschen selbst auch noch in der eigentlichen Körperhaut kleinere durchlöcherte Kalkplatten. Aehnliche finden sich auch in den Tentakeln.

" Es ist mir sehr wahrscheinlich, dass diese 4 Arten nur Varietäten einen und derselben Form sind. So lange aber nicht entweder durch die Auffindung zahlreicher Uebergangsformen, oder durch den Nachweis grosser Variabilität in Form und Vorkommen der Kalkkörper an zahlreichen Exemplaren der nordisch-europäis-

chen Art der Beweis ihrer Zusammengehörigkeit geliefert worden ist, wird man dieselben doch noch als Arten auseinanderhalten müssen." (SEMPER).

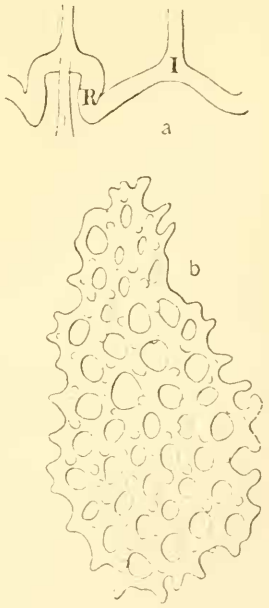
Remarks:—A comparison of some specimens of *Cucumaria frondosa* from Eastport, Maine, with this species shows striking similarities between them in many anatomical details as SEMPER states, but I find in the latter several not unimportant points somewhat different from SEMPER's description.

Unfortunately I can not make out distinctly what the distribution of pedicels and papillæ is in this species. In a specimen 13.5 cm. long and 7 cm. broad (Pl. VIII., figs. 67—68), I find the three ventral ambulacral zones tolerably well-defined; the pedicels in the extreme ends of these zones seem to be in two rows, but in the middle region they are in from three to four rows, which condition is probably due to the contracted state of the specimen, and I should not be surprised if the pedicels are normally, and really two-rowed in each ambulacrum. In the ventrum, moreover, the pedicels are confined to the ambulacra, the interambulacra being entirely devoid of them. In the dorsal region, on the contrary, the interambulacra show pedicels. Further, all over the dorsal region, I see large tubercle-like elevations 0.1 cm. or more across, each of which seems to end in a papilla or a pedicel —I can not exactly make out which, though I am inclined to consider it to be a papilla.

Tentacles are all of a similar size, and extremely bushy in appearance; they number ten. SEMPER states that there is almost no trace of a calcareous ring. Such is not the case in the specimens I have examined. Although not so strongly developed as in some other species, I can easily make out its shape, which is as shown in textfig. 48*a*. Reproductive tubes are extremely numerous,

bushy and unbranched. They spring from a point nearly halfway back in the body length. As in *Cucumaria frondosa*, there is one extremely long Polian vesicle, which in one specimen I have found to be 14 cm. long, being longer than the body itself. The madreporic body is rather large and globular. LAMPERT states that in the specimens from Georgia, he saw an enormous number of small, 1 mm. long vesicles attached to the ring-canal. I do not find such vesicles in my specimens.

One of the characteristic points of this species, as brought out by SEMPER, is that there are large, radially placed calcareous plates near the cloacal opening. CLARK says these plates are not at all noticeable in the Alaskan specimens. Neither can I find them in my specimens. Calcareous bodies found in the skin are very much like those depicted by SEMPER in his Fig. 18, Taf. XXXIX. They are irregular latticed plates with serrated margin and more or less beset with knobs (*b*). Their size varies from 0.192 to 0.280 mm. They show a tendency to be less broad at one end than at the other. In large specimens, they are apt to be very sparsely scattered, so that they may often be overlooked. What THÉEL says in regard to the calcareous plates of *C. frondosa* seems to be largely true in this species also; in fact the irregularly formed plates with uneven or spinous margin are as a rule rare in the old specimens, and are usually found only in the pedicels or in their neighborhood.



Textfig. 48.
Cucumaria japonica: *a*—Calcareous ring; *b*—Perforated plate of perisome. × 240. I—Interradialia; R—Radialia.

I should like to say one word in regard to the distribution of this species. The Japanese specimens are all from the colder parts of Japan. The species does not seem to occur south of Sendai. I am therefore rather surprised that it has been reported from the Moluccas by SLUITER.

This is one of the few species of holothurians known in Japan from olden times under the name of "Kinko."

Locality:—Japan (SEMPER, et al.); Gulf of Georgia (LAMPERT '85); Moluccas (SLUITER '95); Sitka (CLARK '02).

60. *Cucumaria multipes* THÉEL.

(Pl. VIII., fig. 69; textfig. 49).

Cucumaria multipes THÉEL 1886*a*, p. 72, Pl. IV., fig. 4.—LUDWIG 1889—'92, p. 344.

Specimens examined:—

Sci. Coll., Spec. No.	No. of individuals	Preservation	Locality	Collector	Date
1080	1	Alc.	Yokohama Harbor	Mitsukuri	Jan. 13, '94.
1618	1	„	Mombetsu, Hokkaido.	Hatta	Dec. '05

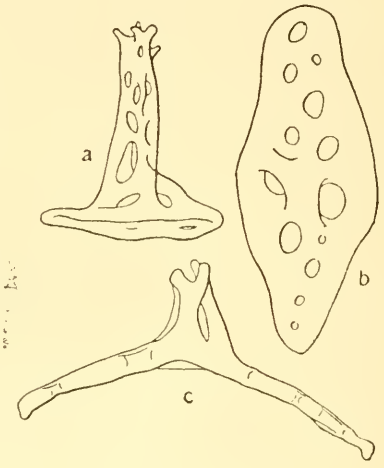
Description:—"Body cylindrical, without any elevations or processes. Pedicels very crowded, disposed in a double row along each ambulacrum, rather long and probably not retractile. Tentacles, calcareous ring and inner organs unknown. Deposits—numerous densely crowded tables with irregularly rounded or mostly elongate, fusiform disks supporting an irregular spire which usually seems to be composed of four rods. The pedicels supported by terminal plates and closely packed transverse tables with the disks narrow and rod-like. Colour in alcohol, light grey." (THÉEL).

Remarks:—Whatever may be the relation of this species to other species more or less resembling it, there can be no doubt that the specimens before me belong to the same species as that described as *C. multipes* by Théel from the same locality. The specimen is cylindrical and rather large, being 6.7 cm. long and 2.5 cm. broad. It ends bluntly at both ends. There are two distinct rows of numerous crowded pedicels along each of the five ambulacra, and there are clearly no pedicels in any of the interambulacra. The specimen in alcohol shows many transverse wrinkles. I can not detect any calcareous teeth around the anus. Owing to the imperfect state of his specimen, Théel was unable to make out the calcareous ring or other anatomical details.

Tentacles ten; the two ventral ones small. Polian vesicles two. Stone-canals in the dorsal mesentery two in number, with lateral madreporic bodies at the end. Calcareous ring as in *C. chronhjelmi*, the midventral radialia and the two adjoining ventral interradialia being fused together into a piece which is anteriorly three-pointed and posteriorly runs into two prolongations. Other radialia and interradialia are separate; each of the radialia being triangular in shape, pointed anteriorly and with two posterior prolongations; the interradialia sagittate, without any posterior prolongations. The retractor muscles bipartite, and becoming free at about $\frac{1}{4}$ of the body-length from the anterior end.

Calcareous deposits are tables only. These are thickly crowded. The disk is irregularly rounded or multiangular; its shape commonly oval or elongate fusiform with one or both ends slightly drawn out (textfig. 49 b). They show a number of holes, among which four principal ones can be easily recognized in most cases. In the larger tables, the spire is generally reduced to a single arch stretching longitudinally between two of the principal holes. Some

tables, especially the small ones, have a well-developed spire (*a*), but it is not so firmly and regularly developed as in the tables of aspidochirote forms. The four columns are more or less bent, and the cross-beams are irregular, so that the holes are arranged in a more or less net-like manner. The teeth at the top are generally not very distinct. The supporting rods of the pedicels are modified tables, but here the disk is much narrower, rod-like, and transverse in position, and is supplied with fewer holes, of which four or more are situated in the dilated middle parts of the disk (*c*). The spire is also more or less irregular.



Textfig. 49.

Cucumaria multipes: *a*—Small table with well-developed spire; *b*—Table with reduced spire; *c*—Supporting rod (× 240).

According to Théel, *C. populifera* Stimpson is the only other species with tables only. But Théel is inclined to think that these are of a different form in that species. At any rate, Théel's *C. multipes* is the only species of which the description is unmistakable. Again, this species is said to be undoubtedly allied to *C. longipeda* Semper and v. Marenzeller, which species is recorded by the latter author from both China and Japan. While indeed its calcareous deposits (Taf. XIII., Fig. 9) and calcareous ring (Taf. XIV., Fig. 7) have some resemblance to same of the present species, it is so totally different in its general configuration and in the presence of pedicels in the ventral interambulacra, that I am inclined to maintain the specific independence of *C. multipes* from *C. longipeda*.

Locality:—Yokohama (Théel '86); Hokkaido.

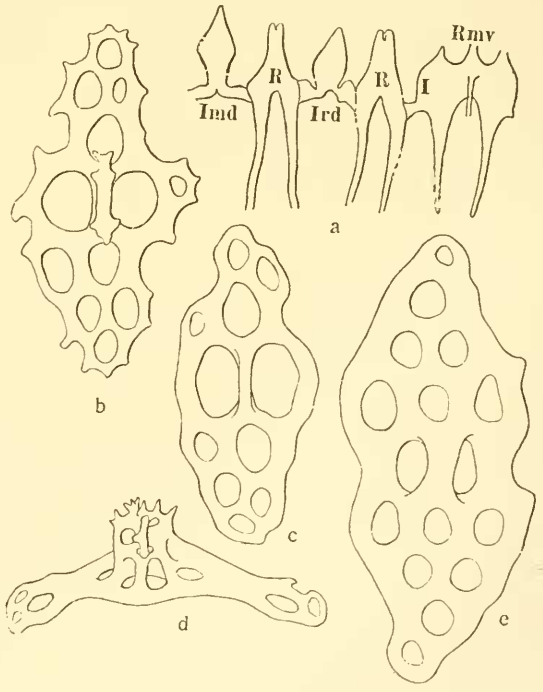
61. *Cucumaria nozawai*, sp. n.

(Pl. I., fig. 12; textfig. 50).

Specimen examined:—One alcoholic specimen from Ishizaki, Prov. Oshima, Hokkaidō. Collected by Nozawa in July 1890 (Sci. Coll., Spec. No. 1085).

Description:—The specimen, which shows many wrinkles and is undoubtedly much contracted, is barrel-shaped, i.e., bluntly and broadly truncated at both ends.

There are no pedicels in any of the interambulacra, either dorsal or ventral. There are two rows of pedicels along each ambulacrum, in which I am able to count about 42 pairs of them. The skin is soft and pliable, although the scissors, in cutting it, make a slight grating sound, indicating that calcareous deposits are numerous. Polian vesicle one, vesicular, attached to the ventral median radius. Stone-canal one, attached to the dorsal mesentery. Respiratory trees present. Tentacles ten; two ventral tentacles smaller than the rest. Calcareous ring as



Textfig. 50.

Cucumaria nozawai: *a*—Calcareous ring; *b*—Table from the wall of pharyngeal mass; *c*—Table of perisome; *d*—Supporting rod of pedicel; *e*—Large table rarely found. (*b*—*e* × 300). I—Right ventral interradialia; Imd—Middorsal interradialia; Ird—Right dorsal interradialia; R—Radialia; Rmv—Midventral radialia.

shown in textfig. 50 *a*. Like so many other species of *Cucumaria*, the ventral median radius and its two adjoining interradii are fused into a large three-pointed piece. Posterior prolongations present on the radii, none on the interradii. Retractors divided at about the middle of the body-length.

Calcareous deposits:—Nearly all are tables with imperfect spire (*c*). The disk is more or less lozenge-shaped; with four, easily distinguishable, principal holes, in additon to which there is a larger or smaller number of accessory holes. The whole looks rather delicate. All have smooth margins. Occasionally there occur unusually large ones (*e*). These disks are each provided with an imperfect spire. This is often represented by nothing more than two knobs situated in longitudinal line; but it is as often built into an irregular spire, generally with only two columns. These spicules are evenly spread in the perisome, so that they can not be described as being crowded or heaped up in layers. In the pedicels, spicules are modified into supporting rods, becoming much elongated transversely (*d*); in the enlarged middle of the biscuit-shaped disk there are the four principal holes, over which is built a more or less imperfect spire. Both ends are also slightly enlarged with one or more holes. In the wall of the pharyngeal mass, there are spicules which are similar to those in the perisome, but are larger and have serrated margins (*b*). In the tentacles, again, there are similar spicules in the branches; but on the stem, they become modified into supporting rods of a much elongated shape. These have, besides the four principal holes in the enlarged middle, a series of other holes extending into each arm and sometimes showing an increase in their number and width towards both ends.

Remarks:—This seems to be a well marked species, and yet

I can not identify it with any of those hitherto described.

I name the species for Mr. S. Nozawa, naturalist to the Hokkaidō local government, who for years has done so much for the zoölogy and fisheries of that island.

62. *Cucumaria obunca* Lampert.

Cucumaria obunca Lampert 1885, p. 250, Fig. 55.—Théel 1886 *a*, p. 265.—Ludwig 1889—'92, p. 344.

Specimens examined:—2 alcoholic specimens from Asamushi near Aomori. Collected by I. Ikeda in July 1900 (Sci. Coll., Spec. No. 1622).

Description:—"In jedem Ambulacrum eine zweizeilige Füsschenreihe; in jeder Reihe stehen ca. 30 Füsschen, die völlig einziehbar sind und ausgestreckt eine Länge von 4 mm. besitzen. Der ganze Schlundkopf ist äusserst klein, blos 3 mm. lang; die Glieder des Kalkrings sind dem entsprechend winzig und blos ½ mm. hoch. Die Interradialia sind etwas niedriger als die Radialia, die auch vorn eine grössere Breite besitzen, als die spitz zulaufenden Interradialien. Die Kalkkörper bieten die bei den Dendrochiroten nicht selten auftretende Form eines Stühlchens, dessen aus zwei Stützen bestehender Stiel zu Knoten reducirt erscheint, und sind in Fig. 55 abgebildet; die Füsschen besitzen eine Endscheibe. Ansatzstelle der Retractoren 9 mm vor dem Vorderende. Die überhaupt nicht starken Längsmuskeln verlaufen nach Abgang der Retractoren in gleicher Stärke bis zum Vorderende. Da das Thier in seiner ganzen Länge dick erfüllt war von einer grossen Masse fest zusammengeballter und sehr bröcklicher Geschlechtsschläuche, so konnte ich Polische Blase und Steinkanal trotz mühevollen Suchens nicht auffinden; beide Organe sind

jedenfalls sehr klein. Die Haut ist dünn, aber durch die reichliche Kalkablagerung ziemlich steif ; 3 cm lang, 0,9 cm breit. Weiss. In ihrem Habitus erinnert die Art an *Cuc. cucumis*, von welcher sie sich durch die Kalkkörper unterscheidet." (LAMPERT).

Remarks :—It is not without some hesitation that I identify these specimens with LAMPERT's *C. obtnca*, as there are some discrepancies between them and LAMPERT's description. But the proximity of the localities and the fact that the calcareous deposits are alike, make me think that they can belong only to this species,

Of the two specimens, the larger is 3.4 cm. long and 1.5 cm. broad, but the strongly wrinkled state of the body indicates that it must have been much longer in life. There are two rows of pedicels in each ambulacrum, with none in any interambulacrum. LAMPERT says there are some 30 pedicels in each row, but in the specimen now before me, there are over 50 pairs of them in each ambulacrum. On opening the body it was found to be full of a large mass of genital tubes rolled up into a bunch. I was unable to find any pharyngeal mass, it having probably been discharged. Hence I could not make out any calcareous ring. Neither have I been able to discover any part of the intestine. The body is somewhat pentagonal. The calcareous deposits are very thickly heaped up in the skin. In the body itself, they consist almost entirely of four-holed, smooth-edged buttons or imperfect tables. These consist of a disk, on which stands in many cases an imperfect spire, consisting of two columns and a cross-beam. The cross-beam often extends beyond the two supports, and, bending down, unites with the edge of the disk. I can not discover reticulated ellipses anywhere in the body itself. In pedicels, the buttons become much elongated and lozenge-shaped, with four

holes in the middle parts and two wings with holes extending out laterally very much as in the similar bodies in the pedicels of *C. chronhjelmi*. Moreover, on the outside of these supports, there are bodies, thinly scattered in a layer, which appear to be the "reticulated ellipses," very much as in *C. chronhjelmi*.

The smaller specimen is 1.4 cm. × 0.4 cm. large, with over 26 pairs of pedicels in each ambulacrum. The pharyngeal mass is entirely drawn in, and contrary to LAMPERT's description, is not unusually small, being 4 mm. long. In this specimen I have detected the calcareous ring. One Polian vesicle was also visible, but I could not ascertain the presence of a stone-canal.

In both specimens the color was observed by Mr. IKEDA, the collector, to be reddish-orange in the fresh state.

The specimens closely resemble *C. chronhjelmi*, and if the layer of reticulated ellipses in the pedicels extended to the body perisome, I should not hesitate to assign them to that species; but as that is not the case I have put them in this species.

Locality:—Hakodate (LAMPERT '85); Asamushi near Aomori.

63. *Cucumaria squamulosa*, sp. n.

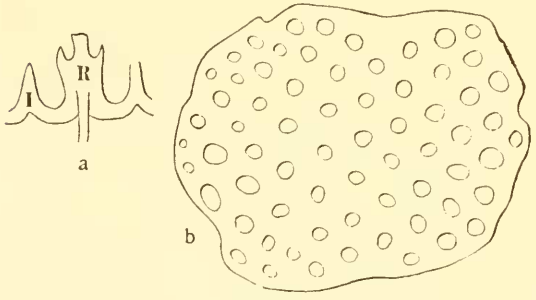
(Pl. VIII., fig. 75; textfig. 51).

Specimen examined:—One alcoholic specimen from Uraga Channel, 150 fms. Collected by Mr. A. Owston on Aug. 6, 1899 (Sci. Coll., Spec. No. 1131).

Description:—The specimen is 2.7 cm. long and 0.6 cm. broad. It is spindle-shaped, tapering towards both extremities. It is slightly curved so as to be concave on the ventral surface, but this shape is probably accidental and owing to preservation. There are two rows of pedicels along each ambulacrum. On the three

ventral ambulacra the pedicels, especially in the middle part, are more crowded than on the bivium. The interambulacra are free of pedicels and papillae on both dorsal and ventral surfaces. Tentacles ten, the two ventral ones small. Although I am unable to make a searching examination on this unique specimen, the tentacles appear to me not to have the usual dendritic shape, but to be formed of a series of flat plates attached along the stem, somewhat in the fashion of cephalopod gills. Of the calcareous ring, the radialia are three-pointed anteriorly, while the interradialia are single-pointed (textfig. 51 *a*). No posterior prolongations on either. There is one large stone-canal.

The calcareous deposits are abundant. They entirely cover the body like armor. They consist each of a large smooth-edged plate with numerous holes in it. Here and there, mixed with these plates, are smaller ones which have a far smaller number of holes (*b*). These smaller plates are especially heaped up at the base and on the sides of pedicels which have end-plates. In the tentacles, there are also supporting rods which are spiny.



Textfig. 51.

Cucumaria squamulosa : *a*—Calcareous ring; *b*—Smaller perforated plate, × 60. I—Interradialia; R—Radialia.

Remarks :—This species is undoubtedly near *C. munita* Sluiter and *C. hyndmanni* Thompson. However, it differs from the former in having calcareous deposits crowded in the pedicels, and from the latter in the shape of the supporting rods in the pedicels. I can not identify this species with any hitherto described, and am therefore obliged to establish a new species for it.

64. *Cucumaria vegæ* Théel.

(Pl. I., fig. 9).

Cucumaria vegæ Théel 1886 *a*, p. 114.—Ludwig 1889—'92, p. 344.—Clark 1902 *a*, pp. 563–4.

Specimens examined :—

Sci. Coll., Spec. No.	No. of individuals	Preservation	Locality	Collector	Date
1092	1	Alc.	Hokkaidō	Nozawa	Feb. 15, '97.
1614	1	„	Hakodaté, Hokkaidō.	Hatta	Dec. '05.

Description :—" Body more or less obviously curved, tapering nearly equally towards each extremity. Tentacles ten, two ventral smaller. Anus with five teeth, made up of a calcareous network. Pedicels in a distinct double row on each of the ventral ambulacra and in a less distinct double row on the two dorsal ; smaller pedicels are also to be found scattered over the five interambulacra of the larger specimen, while in the smaller individuals the ventral interambulacra seem to be almost naked. A single Polian vesicle and madreporic canal present. Calcareous ring very slender, devoid of posterior prolongations. Deposits more thinly scattered, of two kinds ; smooth rods, typically with a hole in each slightly enlarged end, thus resembling spectacles, but often of a more irregular form, more or less curved, with several, often three, holes placed at each end ; and here and there smooth plates with uneven, undulating margin, and pierced with a varying number of round holes. The surfaces of the plates and rods are not quite level, owing to some very low, nearly inconspicuous elevations. Pedicels

with a very fragmentary terminal plate or none at all, but devoid of any other supporting rods than such as are found in the body-wall itself. Length of the largest specimen, 38 mm. Colour in alcohol: dorsal surface and the ends of the body, dirty brown; ventral surface, yellowish-grey. Possibly this species may be nearly allied to *Cucumaria nigricans*." (THÉEL).

Remarks:—In one specimen (No. 1092), the body tapers about equally towards both extremities. In the other it becomes much more slender posteriorly than anteriorly. The first specimen is curved in on the ventral side, and the second on the dorsal. The former 3.8 cm. long and 1.7 cm. broad; the latter 4 cm. long and 1.4 cm. broad. Both of the same coloration, i. e., dark brown on the dorsal surface and lighter brown on the ventral. In the first specimen, there is a dark, nearly black, band along the dorsal median line. In the same specimen, I was able to demonstrate five irregular anal plates made up of calcareous network; they scarcely deserve to be called teeth. Pedicels in two rows along each ambulacrum; also present in scattered distribution in all interambulacra. In the second specimen, the pedicels assumed an irregularly two-rowed arrangement in each interambulacrum. Polian vesicle and stone-canal one each. Calcareous ring slender and very imperfectly calcified. Respiratory trees present.

Calcareous deposits as described dy THÉEL. Most numerous are the spectacle-like bodies, with a hole in each enlarged end. The holes may increase in number and the form of the bodies may become more irregular, finally transforming themselves into irregular plates perforated by numerous holes. The bodies found in the wall of pedicels are much more slender than those in other parts of the body, though similar in other respects. Terminal plates of pedicels rudimentary or wanting.

Locality :—Behring I. (Théel '86); Copper I. (Clark '02); St. Paul I., Pribilof Is. (Clark '02); Sitka (Clark '02); Hokkaidō.

Genus **Pseudocucumis** Ludwig 1875.

65. *Pseudocucumis africana* (Semper).

(Pl. VIII., fig. 66; textfig. 52).

Cucumaria africana Semper 1867—'68, p. 53, Taf. XV., Fig. 16.—Haacke 1880, p. 46.—Ludwig 1883, p. 161.—Lampert 1885, p. 137.—Théel 1886 *a*, p. 108.

Pseudocucumis theeli Ludwig 1887, p. 1236, Fig. 12—16.

Pseudocucumis africana Ludwig 1888, p. 815.—Ludwig 1889—'92, p. 348.—Koehler 1895 *d*, p. 276.—Lampert 1896, p. 61.—Bedford 1899 *a*, p. 843.—Bedford 1899 *b*, p. 144.—Ludwig 1899, p. 561.—Sluiter 1901 *b*, p. 107.

Specimens examined :—

Sci. Coll., Spec. No.	No. of individuals	Locality	Collector	Date
1627	Many	Shimokataura, Prov. Satsuma (littoral).	Miyajima	Jul. 25, '99.
1238	Many	Sakibaru in Naha, Okinawa I. (on dead coral reef).	Mitsukuri, Ikeda et al.	Apr. 7, '01.
1628	2	Mizoe, Ariake Bay, Prov. Hyūga (littoral).	Mitsukui & Hara	Apr. 2, '96.
1629	2	Ushiuchi-mura, Shimokoshiki I., Prov. Satsuma (littoral).	Miyajima	Jul. 18, '99.
1251	3	Shimabira, Prov. Satsuma (littoral).	Mitsukui & Hara	Apr. 18, '96.
1243	2	Natsui, Prov. Hyūga (littoral).	,,	Apr. 13, '96.
1631	4	Nasé, Amami-Ōshima (littoral).	Yoshiwara	Feb., '00.
1633	5	Ushifuka, Amakusa, Prov. Hizen.	Aida	Aug. 5, '00.

Sci. Coll., Spec. No.	No. of individuals	Locality	Collector	Date
Agassiz No. 1.	5	Kusaie, Caroline Is.	"Albatross"	Feb. 8, '00.
1300	1	Amami-Ōshima	Mitsukuri & Ikeda	Mar.—Apr., '01.
1634	5	Nase, Amami-Ōshima.	Yoshiwara	Feb., '00.
1635	1	Tomari-mura near Naha, Okinawa.	Miyajima	
1072	Several	Natsui, Prov. Hyūga.	Mitsukuri & Hara	Apr., '96.

Description:—"Fast cylindrisch; 40—48 Mm. lang, grösster Durchmesser 10 Mm. In den 5 gesonderten Ambulacren stehen 2 Füsschen nebeneinander; die 3 der Bauchseite stehen etwas näher zusammen. In der Haut grosse, schon mit der Lupe erkennbare Kalkplatten. Der Enddarm ist auffallend weit. Ein dorsaler kleiner Steincanal, dicht daneben links die Polische Blase. Die 5 interradialen Glieder des Kalkringes sind einfach, die radialen mit 2 angelenkten Zipfeln; der mittlere radiale des Triviums ist durch den Ausschnitt für den Nerv in 2 gleiche Hälften getheilt, an den andern dagegen steht er auf einer Seite. Die Retractoren setzen sich auf 1/5 von vorne an. Geschlechtsfollikel einfach, ziemlich lang, ihre Insertion etwas vor der Mitte, etc." (SEMPER).

Remarks:—This is a small-sized species. The largest seems to be about 7 cm. × 1.5 cm. Some specimens are more or less pentagonal in section. The color, when living, is a deep purple on the dorsal surface and ochre yellow on the ventral. The tip of pedicels is purple. In alcohol, the color is more or less faded to various shades of brown, sometimes becoming quite light-colored. The animal is rather common from the southern end of Kyūshū southward. In the reefs around Naha, Okinawa I., it is one of the commonest animals.

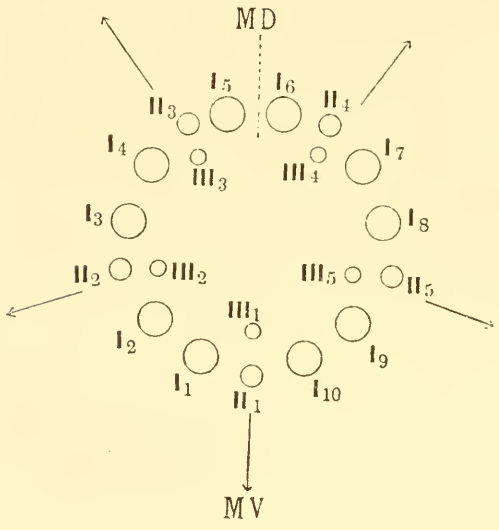
On the ventral trivium, pedicels are distinctly two-rowed and somewhat crowded, while on the dorsal bivium they are rather sparse, although occurring likewise in two rows, so that the dorsal and ventral surfaces can be easily distinguished from the outside. The calcareous ring is as given by Ludwig (1887, Taf. XV., Fig. 12). In one specimen I have detected one stone-canal on the dorsal mesenterium, and one Polian vesicle in a more ventral position. In another specimen, there were two Polian vesicles present. Retractors are attached to the body-wall behind the middle of the body.

The calcareous deposits are exactly as given by Ludwig. Very characteristic huge button-shaped plates with holes and spines are found scattered in the perisome. In the pedicels and around their base there occur longish supporting rods with enlarged and perforated ends. Ludwig has described from the pedicels another kind of supporting rods, viz., more or less irregular plates with many holes, among which the four central ones are distinctly recognizable as such. Plates of this description are not found in my specimens, except in those from Amakusa (No. 1633). In the latter specimens, there occur plates which are exactly like those figured by Ludwig (Taf. XV., Fig. 14).

Tentacles are 20 in number. As given by Ludwig, Bell and Bedford, they are of various sizes, and are arranged in two circles. In detail, I find their arrangement somewhat different from that given by Ludwig (Taf. XV., Fig. 16) or by Bedford (1899 *a*, p. 843). As I have made it out, the arrangement is as indicated in textfig. 52.

The specimens agree so well with the description of *Pseudocucumis theeli* given by Ludwig (1887, p. 1236), which species was later recognized by the same author (1888, p. 815) to be identical with Semper's *Cucumaria africana* or *Pseudocucumis africana*

(Semper), that I have no hesitation in assigning them to that species, and that all the more as the species has been reported from points nearer to Japan than the locality whence it was first described. I have naturally turned to *P. japonica* (Bell) to see if the specimens did not belong to it. Unfortunately Bell's description of that species is rather imperfect. Moreover, that species is said to be devoid of calcareous deposits—which certainly is not the case with my specimens. Again, Bell's specimen came from Tsugaru Strait, while my specimens are all from localities much farther south. Either there is a second totally different species of *Pseudocucumis* from the north, which is to go by the name of *P. japonica* (Bell,), or else the latter species is synonymous with the present species. Future investigations alone can decide the matter.



Textfig. 52.

Pseudocucumis africana: Diagram showing the arrangement and relative size of tentacles. Arrows indicate the 5 ambulacra. MD—Middorsal, MV—Midventral line; I—largest, II—middle-sized, III—smallest-sized tentacles.

Locality:—Querimba (Semper '67—8); Mauritius (Ludwig '83, Haacke '80); Amboina (Ludwig '88); Zanzibar (Ludwig '99); Seychelles (Ludwig '99); Baui (Lampert '96); New Caledonia (Bedford '99); Rotuma (Bedford '99); Karkaralong Group (Sluiter '01); Sarassa (Sluiter '01); Molo Strasse (Sluiter '01); Muaras-Riff (Sluiter '01); Sailus-Ketjil (Sluiter '01); Lamakera, Riff (Sluiter '01); Djampeah (Sluiter '01); Banda (Sluiter

'01); Buka-Bai, Rotti, Riff (SLUITER '01); Roma, Riff. (SLUITER '01); Bima-Bai, Riff (SLUITER '01); Ambon, Riff (SLUITER '01); Lumu-Lumu, Riff (SLUITER '01); Southern Kyūshū and Liukiu Is.

Family IV. MOLPADIIDAE.

Genus **Caudina** STIMPSON 1853.

66. *Caudina ransonnetii* v. MARENZELLER.

(Pl. VIII., fig. 76).

Caudina ransonnetii v. MARENZELLER 1881, p. 126, Taf. IV., Fig. 5.—LUDWIG 1883, p. 158.—LAMPERT 1885, p. 210.—THÉEL 1886 *a*, p. 54.—LUDWIG 1889—'92, p. 354.

Specimens examined :—

Sci. Coll., Spec. No.	No. of individuals	Locality	Collector	Date
1102	38	Zenibako, Hokkaidō.	Hara	Oct. 20, '99.
1661	Several	Hokkaidō	Hatta	Dec., '05.

Description :—"Tentacles fifteen, like those in the preceding species (*C. arenata*, each with about four digits). Deposits—regularly perforated, very flat cups with outwardly, upwardly directed teeth in the margin; the opening of the cups is closed by an X-shaped figure with low-knobs in the centre and at the ends of the arms." (THÉEL p. 54).

Remarks :—The specimens examined by me are somewhat larger than those of v. MARENZELLER : 7.5 cm. × 2 cm. (of which the tail is 2.3 cm.); 8.3 cm × 2.3 cm. (the tail 2.6 cm.); 9.2 cm. × 2.5 cm. (the tail 3.3 cm.)

Tentacles 15, ending in four finger-like processes. Color yellowish-white in alcohol. Longitudinal and circular muscles distinctly recognizable from outside. Calcareous ring as figured by v. MARENZELLER. Radialia have each two posterior prolongations which do not, however, end in sharp points. Anteriorly, they are two-pointed, one point being broad and blunt and the other sharp. Near the end of the former there is a slight hollow for the attachment of longitudinal muscles. Interradialia with one sharp point, much shorter than radialia, without posterior prolongations. Polian vesicle one; stone-canal one. Tentacular ampullae present. In some specimens the genital papilla can be recognized just outside the tentacular circle. Calcareous bodies as figured by v. MARENZELLER.

Localities:—Yellow Sea (v. MARENZELLER '81); Japan (LUDWIG '83); Chefoo (LAMPERT '85); Hokkaidō.

Genus **Trochostoma** DANIELSSEN & KOREN 1877.

67. *Trochostoma andamanense* WALSH.

(Pl. VII., figs. 64—65; textfig. 53).

Trochostoma andamanense WALSH 1891, pp. 197—204.—KOEHLER & VANEY 1905, p. 90, Pl. XIII., figs. 11—15.

Specimens examined :—

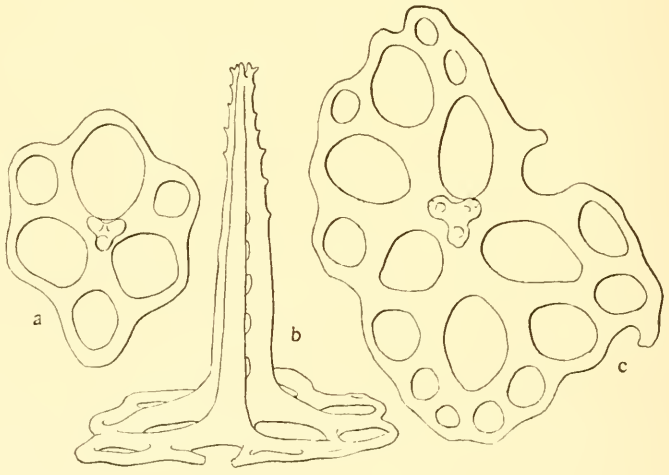
Sci. Coll., Spec. No.	No. of individuals	Locality	Depth in *hiro*	Collector	Date
1662	1	Outside Okinosé, Iwadoline.	350-400	Aoki	Feb. 14, '97.
1663	1	Oustside Okinosé	400	,,	Jan. 28, '04.

Description:—"This species is very closely allied to *T. antarcticum* Théel. Length 90 mm. Body cylindrical and narrowed behind into a tail-like extremity. Skin rough but thin. In spirit the ground colour has become greenish-grey and the spots are more or less blood-red. The tentacles fifteen in number, are yellow and between every two there is, near the base, a blue-black triangular mark. Each tentacle has three very small digits at the free end. Mouth and anus terminal, the latter without teeth, but in one specimen, with numerous fine papillae. One Polian vesicle, one free stone-canal; 2 (3 ?) lungs, not much branched; one bundle of yellow genital tubes. The radii of the calcareous ring are produced backwards as spines. Calcareous bodies not very numerous consisting of a few wide-holed plates and tower-like rods which are perforated with 4 to 6 holes. Under the microscope the 'chocolate spots' are seen to be composed of rust-red ovoid bodies with a concentric arrangement. They are insoluble in caustic potash. Colour when fresh 'dirty flesh-colour with closely placed deep chocolate spots; the crown (tentacles) being a sort of raw-meat-colour.'" (Walsh p. 204).

Remarks:—The two specimens at my disposal are somewhat different in their external appearance. The appearance of the first specimen is given in figs. 64—65, Pl. VII. It is greenish-yellow all over the body, green predominating towards the posterior end. The second specimen has much less color. It is greenish-yellow only near the anterior end, the remaining portions being in most parts nearly colorless and translucent, changing into almost white in the tail. The skin in both is thin; in the first specimen it is rough to the touch, but in the second specimen it is much softer. The measurements are as follows. No. 1672: 8.0 cm. in length, 2.1 cm. in diameter, tail short and only 1 cm. long;

No. 1663 : 7.9 cm. in length, 2.1 cm. in diameter, tail 0.9 cm. long. Oral disk is 4.5 mm. in the former and 8 mm. in the latter, the difference being due mostly to the state of contraction. Tentacles 15 in number, each probably with two processes near the free end, but this point I was not able to make out definitely. The calcareous ring is solid. The radialia have a posteriorly directed process and end anteriorly in a tooth. In the region corresponding to interradialia there are one or two grooves and as many anteriorly directed processes. There is a stone-canal with a comparatively large madreporic body. Polian vesicle one. In the first specimen there are some minute papillae around the anus.

Calcareous deposits :—I can not discover any distinct wine-red particles. But there is a deposit of a greenish-yellow substance around the table, and especially around the spire. This probably produces the general coloring of the body. Although the deposit is amorphous and of no definite shape, I think it more than probable that it represents the wine-red particles. I agree with THÉEL in thinking that the presence or absence of wine-red particles can not be made a specific character. The characteristic table of this



Textfig. 53.

Trochostoma andamanense : *a*—Small table ; *b*, *c*—Large tables. (× 150).

species is given in textfig. 53 *a*—*c*. The disk of the table is more or less round in outline. It has three large holes, alternating with which there are three smaller holes (*a*). On this disk rises a high spire, consisting of three columns with several cross-bars. In most cases there are teeth on the outer side of the columns. Sometimes the holes remain open, as in *c*. Towards the anterior end of body the tables are similar in shape and become somewhat smaller. Towards the posterior end, the disks of the tables become more complex, extending themselves in two or more diameters and thus becoming lozenge-shaped, triangular, or square (*b*, *c*). The disks also exhibit a larger number of holes.

I agree with WALSH in considering these specimens to be very close to *T. antarcticum* THÉEL, but they agree better with *T. andamanense* WALSH.

Locality :—S.E. of Cinque I., Andaman Sea (WALSH '91); "Investigator" Stats. 222, 233, 234, 235, 263, 265 (KOEHLER & VANEY '05); Sagami Sea.

Genus **Ankyroderma** DANIELSSEN & KOREN 1879.

68. *Ankyroderma diomedeæ*, sp. n.

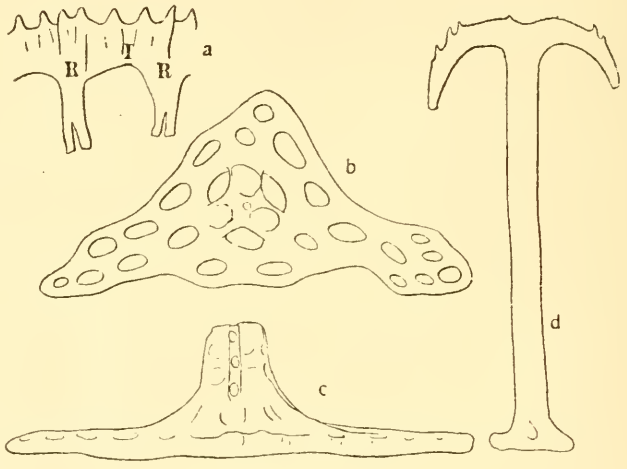
(Pl. VIII., fig. 77; textfig. 54).

Specimen examined :—One individual from off the mouth of the River Ōigawa, "Albatross" Stat. 5073, lat. 34° 46′ N. and long. 138° 21′ 50″ E., 148 fms. Oct. 16, 1906. (No. 5073).

Description :—The body is 8 cm. long and the tail 3.1 cm. The skin is much transversely wrinkled and feels rough to the touch. In the middle third of the body, there are visible even to the naked eye little scattered elevations, which mark the places

where the clusters of spoon-shaped deposits are found and from which the anchors protrude. They are, however, mostly broken off. The tentacles are 15, all withdrawn, and I can not determine how many, if any, lateral appendages are attached to each of them. The calcareous ring as figured in textfig. 54 *a*.

The radialia have posterior prolongations ending posteriorly in two points. Anteriorly they end in two points. The interradialia have posterior prolongations, but present a round scalloped posterior margin, and have two points anteriorly. One Polian vesicle, which is ovoid and has a length of 5 mm., its stalk also 5 mm. long. Along the free edge of the dorsal mesentery turned toward the gullet, there runs a stone-canal, which presents near its superior termination some convolutions and a madreporic knob. The respiratory tree is well developed. Its left branch is produced anteriorly and becomes attached to the gullet as was stated by THÉEL (1886, p. 39) for *A. danielsseni*.



Textfig. 54.

Ankyroderma diomedeæ:—*a* Calcareous ring; *b*, *c*—Tables; *d*—Anchor. (*b*—*d* × 150). I—Interradialia; R.—Radialia.

The calcareous deposits are very characteristic and establish the species. Here and there, we see, as in all the species of *Ankyroderma*, clusters of spoon-like bodies from which anchors stand out (*d*). These have some teeth on the outside of their

flukes. Besides these, the skin is closely packed everywhere with large irregular tables (*b*, *c*). These have large disks which have many holes. The disks measured presented the following dimensions: 0.30 mm. × 0.19 mm.; 0.40 mm. × 0.18 mm.; 0.45 mm. × 0.19 mm.; 0.42 mm. × 0.20 mm.; 0.40 mm. × 0.25 mm.; 0.47 × 0.16 mm. Many of them show prolongations in two, very often in three diameters. Anteriorly and posteriorly, they become more or less elongated. Many disks show a change into wine-red substance, as stated for *A. roretzii*. On the disk there arises a spire which is quite high, 0.18—0.20 mm., and consists of three or four, oftener four, columns. One observes from seven to nine cross-bars, but these have a very peculiar arrangement: i.e., those on the four sides of the spire are at different levels, so that in transparent views, the openings to the outside of the spire appear to be alternately disposed on different sides. Wine-red corpuscles are present but not in such a profuse quantity as in some other species of *Ankyroderma*.

Remarks:—This is a somewhat large form and appears to be near *A. maroccanum* Perrier, but the calcareous spicules are quite different. I can not identify it with any hitherto described species, and am obliged to make a new species of it.

69. *Ankyroderma roretzii* v. Marenzeller.

(Pl. VIII., fig. 78; textfig. 55).

Ankyroderma roretzii v. Marenzeller 1881, pp. 124—6, Taf. IV., Fig. 4.—Lampert 1885, p. 213, Fig. 69.—Ludwig 1889—'92, p. 355.—Ludwig 1891, p. 584.

Ankyroderma (*Haplodactyla*) *roretzii* Théel 1886 *a*, p. 49.

Ankyroderma simile Théel 1886 *a*, p. 40, Pl. II., fig. 5; Pl. XI., fig. 2. —Ludwig 1889—'92, p. 355.— Ludwig 1891, p. 584.

Specimens examined :—

Sci. Coll., Spec. No.	No. of individuals	Preservation	Locality	Depth in *hiro*	Collector	Date
1129	1	Alc.	Uraga Channel	84	A. Owston	Nov. 5, '99.
1665	1	„	„	60	„	
1666	1	„	Naka-no-Yodomi, Yahagi-line, Mera not out, Sagami Sea.	330	Mitsukuri & Aoki	

Description :—" Körper des einzigen Exemplares 43 mm. lang, ohne den schwanzähnlichen Anhang, der 12 mm. misst, in der Mitte 30 mm. breit, nach vorn verschmälert, quer abgestutzt. Der Schwanz am Ursprunge 4 mm., am Ende 2 mm. breit. Die Farbe dunkelvioletbraun, nur der Schwanz weiss. Kleine weisse Papillen erheben sich über den dunklen Grund. 15 dreigelappte Tentakel. Die seitlichen Lappen sehr klein, der mittlere wenigstens viermal so breit. Eine Genitalpapille nicht bemerklich.....Der Kalkring vollständig verwachsen. Die Radialia 7 mm. lang, unter sich nicht auffallend ungleich lang, nach hinten in einen am Ende leicht ausgerandeten Fortsatz übergehend, vorn mit einer stärkeren längeren und 2 kleineren kürzeren Spitzen endend. Die letzteren dienen den Radialmuskeln zum Ansatze.....Auch die Interradialia sind scharf gekantet.....Jedem Radiale entspricht ein Tentakel mit einer Ampulle,.....In jedem Interradialraume zwei Tentakel.....Eine Poli'sche Blase von 13 mm. Länge. Ein 10 mm. langer Steincanal mit einem Madreporenköpfchen kurz vor der Befestigung an die Leibeswand. Die Geschlechtsfollikel .....in 2 Hauptbüschel.....

Die charakteristischen Kalkkörper in den kleinen Papillen, meist zu fünf liegend, sind eigentlich nicht spatelförmig,..... sondern löffelförmig. Die Löffeln überdecken sich gegenseitig, das Ende des Stieles ist ausgezackt. Eine zweite Art von Kalkkörper tritt in wechselnder Form auf. Es sind runde durchlöcherte Schalen mit einem sehr langen undurchbrochenen Stiele. Die Spitze, welche ich immer nur abgebrochen sah, ragt aus der Haut heraus. Ferner solche mit weniger regelmässiger Basis und reicher zu dem Stiele sich hinüber wölbender Spangenbildung; an diesen sieht man den Stiel nicht compact,.....sondern man erkennt Lücken und die Zusammensetzung aus drei Stäben. Neben diesen zwei ausgeprägteren Formen findet man häufig arbortirte. Endlich erfüllen die Haut in dichter Lage die braunen geschichteten Körper. An dem Schwanze fehlen diese, daher ist auch die Farbe weiss und sie werden dort durch ebenso dicht gelagerte durchsichtige Kalkkörper ersetzt, die von denen des eigentlichen Leibes wesentlich abweichen, im Ganzen aber die grösste Aehnlichkeit mit den an gleicher Stelle bei *Trochostoma*- und den anderen *Ankyroderma*-Arten beobachteten zeigen. Es sind durchlöcherte, in der Mitte verbreiterte, links und rechts schmal auslaufende Platten, von deren Mitte sich ein dreigliedriger Stiel erhebt, der in eine Dornenkrone ausgeht. Manchmal nehmen die Scheiben eine mehr rundliche Gestalt an." (v. Marenzeller pp. 125—6).

"Body fusiform, anteriorly truncated, posteriorly decreasing into a narrow caudal portion. Tentacles fifteen, comparatively large, and provided with a pair of minute processes near the rounded ends. Anus surrounded by five calcareous teeth and fifteen minute cylindrical papillæ, disposed in groups of one tooth and three papillæ in each. Calcareous deposits very scattered—small rounded reddish or light brownish bodies, mostly aggregated into smaller

masses ; small and thinly scattered rings supporting a crown of three to four straight, outwardly directed, rods; and very thinly dispersed star-like deposits, consisting of about five spoon-like rods, with the enlarged perforated ends overlapping one another, and a long straight outwardly directed central rod, the top of which is provided with two curved arms thus bearing some resemblance to the anchors in *Synapta*. Colour in alcohol dirty grey and yellowish-brown. Length 100 to 110 mm." (THÉEL p. 40).

Remarks :—The species of *Ankyroderma* are very difficult to identify. As to *A. simile*, there are some discrepancies between the description of v. MARENZELLER and that of THÉEL. My specimens may be said to agree with the descriptions in the essential points of structure, and as they came from the same sea—both the " Challenger " and v. MARENZELLER's specimens coming from the Sagami Bay—I have very little doubt in my own mind that they belong to the same species. What has made the identification very difficult is the fact that the older individuals differ considerably from the young, both in color and calcareous deposits.

Of my specimens enumerated above, No. 1666 is in my opinion a very young individual, while No. 1129 is an older individual, and No. 1665 the oldest of the three. The differences in external appearance are striking. In No. 1665 the measurements are as follows : body exclusive of tail 4.4 cm.; tail 0.6 cm. ; total length 5.0 cm. ; diameter of body 1.7 cm. In No. 1129, length of entire body (tail not apparent) 3.5 cm. ; diameter 2 cm. In No. 1666, body exclusive of tail 1.0 cm. long. ; tail 0.5 cm. long. ; total length 1.5 cm. ; diameter 0.8 cm. The oldest individual has a thick, much wrinkled skin and is dull-red in color. No. 1129 has also a wrinkled but thinner skin, and is ashen-grey in color. The

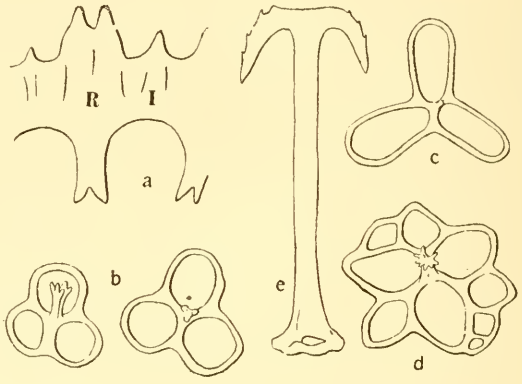
youngest has a thin, transparent skin, and when fresh had a green tinge. In the two specimens in which the tail is apparent, that portion has a light color. At first glance, Nos. 1665 and 1666 are so different that it appears scarcely possible that they belong to the same species. I hope, however, to show that the striking difference in color is due to the formation, in course of life, of the wine-red corpuscles which have been stated to be characteristic of so many species. Of this, more anon.

There are 15 tentacles; all are trifid, e. i., there exists a small papilla near, and on each side of, the tip. The calcareous ring is shown in textfig. 55 *a*. Each of the radialia has a posterior prolongation ending behind in two points. Anteriorly it ends also in two points, to which the longitudinal muscles are attached. Interradialia end in a single point anteriorly, without any posterior prolongation. These are all fused together, and there are some longitudinal grooves. Tentacular ampullæ present. Polian vesicle one. Stone-canal with a madreporic knob present. There are minute papillæ around the anus.

For examination of the calcareous deposits, it is best to cut a longitudinal strip of skin extending from the base of tentacles to the tip of tail, and to mount it whole or in a definite series, so that one can trace changes in the character of the deposits from one end to the other. Characteristic of the genus are clusters of 4—7 spoon-shaped bodies, scattered here and there. In specimen No. 1129., the spoons measure 0.15—0.17 mm. in breadth at the broad portion and 0.38—0.55 mm. in total length. There are many holes in the entire length of the stem, which ends in short irregular teeth. From the center of each cluster, there arises an anchor which protrudes from the skin and may be felt or seen (*c*). Each anchor has a slightly enlarged base perforated by some

holes. The shaft is about 0.30 cm. long and ends distally in two flukes, each of which shows some teeth on the outer side. In one case there were five teeth on one side, and three on the other. The anchor is often broken in the middle of the shaft. In my opinion, v. MARENZELLER's Fig. 4 B *a* represents nothing else than such a broken anchor.

As regards the other kinds of calcareous deposits (*b*—*d*) those in the tail portion of the perisome are larger and more numerous than in more anterior parts. They are nearly all more or less modified tables. The disk in regular ones is mostly lozenge-shaped with four or more large holes, but in others it appears merely like a complex of irregular curves. The measurements of the disks are as follows: 0.24 × 0.09 mm; 0.27 × 0.09 mm.; 0.18 × 0.08 mm.; 0.23 × 0.08 mm.



Textfig. 55.

Ankyroderma roretzii: *a*—Calcareous ring; *b*, *c*—Simple tables; *d*—Table with more holes; *e*—Anchor. (*b*—*e* × 150). I—Interradialia; R—Radialia.

From the disk rises a high spire, which measured in height: 0.15 mm., 0.11 mm., 0.10 mm., 0.11 mm., 0.08 mm. It is mostly very regular, consisting of three columns with five or more cross-bars, the crown ending in a number of teeth. There are, however, irregular incomplete spires too. In the tail portion, wine-red or rather yellowish-brown corpuscles are not so numerous as in more anterior portions. Further, there seem to be present no clusters of spoon-shaped bodies.

Anteriorly beyond the tail portion, calcareous deposits become decidedly more scarce. Those existing there are of about the same character as the tables before mentioned. Clusters of spoon-shaped bodies also make their appearance. There is also noticeable a peculiarity in the tables. Many of these instead of appearing clear and transparent, are surrounded by a peculiar yellowish-brown substance, which seems to be deposited generally outside of the calcareous lattice-work and is without question of the same substance as the wine-red corpuscles. The whole gives an impression of calcareous deposits undergoing some chemical change and degenerating into the wine-red substance. This remarkable transformation has been noticed by every one who has worked on *Ankyroderma* and *Trochostoma*—f. i., by Théel ('86 p. 17), Ludwig ('94 p. 166), Lampert ('89 p. 843). In the middle of the body, the disk of the tables is no longer lozenge-shaped, but mostly circular, and generally provided with three large holes, while the spire, consisting of three pillars, is generally more or less incomplete. The wine-red corpuscles are mostly ellipsoidal, and many of them still retain the outline of a calcareous table. These characters are maintained up to the margin of the mouth or the base of the tentacles. In the anteriormost region, the wine-red corpuscles are mostly ellipsoidal, i. e., the transformation is complete, although transitional stages may be observed in all parts.

Summing up, the rosettes are absent from the tail portion but are scattered everywhere else. The wine-red corpuscles seem to arise by transformation of calcareous tables. Their shape conforms at first to that of the tables, but later seems to break up into ellipses. The calcareous tables are most numerous and complete in the tail portion.. Here their base is a lozenge-shaped disk with three or more perforations and is surmounted by a

high spire with eight or more cross-beams. The tables become incomplete in the body proper, their disk being generally smaller and tri-loculate and their spire more or less incomplete.

In Spec. No. 1665, which seems to be an older individual than Spec. No. 1129 as is clear from its larger size, thicker skin and deeper color, the calcareous deposits are much scarcer than in the latter specimen, while its skin is packed full of wine-red corpuscles. The tail portion alone exhibits calcareous tables in larger numbers. Here all the tables have a lozenge-shaped disk which shows many holes in the enlarged middle parts and is produced into two points at each end. The spire consists of three pillars which are generally broken off near the base. The wine-red corpuscles are rather few in the tail; hence the light color of that part. The whole body, with the exception of the tail, is packed quite thickly with these corpuscles; moreover the stages of transformation, such as were seen in Spec. No. 1129, from calcareous deposits to these corpuscles, are hardly discernible. Tables in the same parts of the body are few and far between.

In Spec. No. 1666, the calcareous deposits show some differences from those of the two specimens described above, but I believe one is justified in placing the three specimens in the same species. The tail portion is again full of calcareous tables. These have lozenge-shaped disks with four or more holes. The spire, which consists of three pillars, is generally low even when complete, and ends in some teeth, but it is usually found broken off. Around the anus, there are five large perforated calcareous plates. In the body above the tail, the calcareous tables have the disk more complete than in corresponding parts of the two last mentioned specimens. The disk is rather delicate and is found in different stages of transformation into the wine-red substance.

It has three large perforations alternating with three smaller holes, often with the addition of some peripheral holes. The spire, consisting of three pillars, is generally conical and low, with two or three cross-beams. Frequently, there are in its place three knobs representing the bases of as many pillars. Wine-red corpuscles are rather scanty.

The above descriptions seem to indicate that the skin is at first thin and transparent. The calcareous deposits are more numerous and more regularly and better formed, the younger the animal is. On the other hand, wine-red corpuscles are scanty in the young animal; hence the want of coloration in it. They increase in number as the animal grows older, and even the deposits that still remain may be transformed partially and in varying degrees into the wine-red substance, thus causing the red coloring of the older individuals.

I can not distinguish *Ankyroderma simile* of THÉEL from *A. roretzii* of v. MARENZELLER; it is possible that this is due to the insufficiency of the descriptions. But when it is remembered that the "Challenger" specimens, v. MARENZELLER's specimens and my own have all come from almost the same spot in the Sagami Sea, it seems reasonable to conclude that they all belong to one and the same species.

Locality:—Japan (v. MARENZELLER '81).; "Challenger" Stat. 232, Sagami Sea (THÉEL '86).

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